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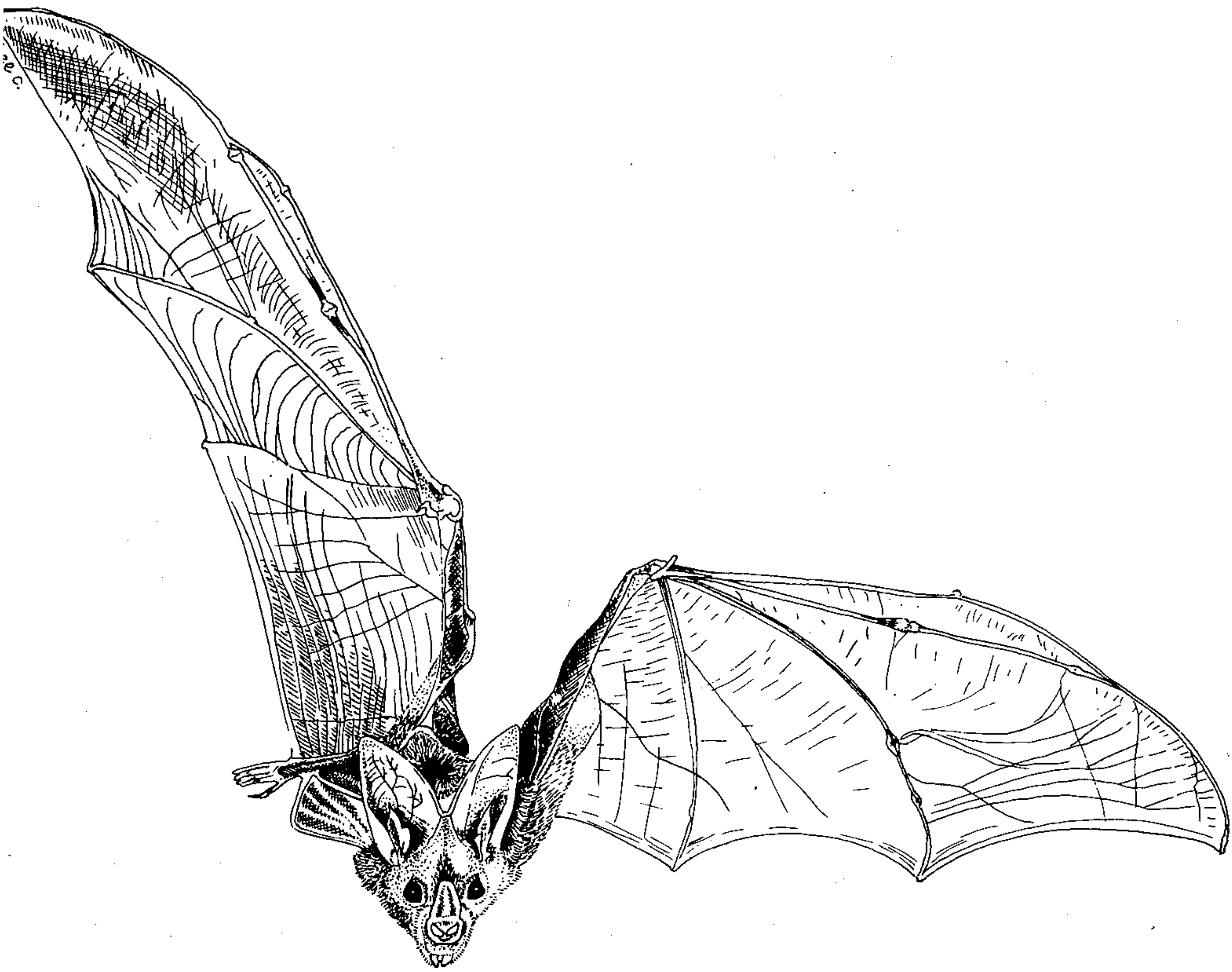

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SHORT COMMUNICATIONS

PROTECTING BAT CAVES

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Australian cave bats have been relatively undisturbed in their caves, partly because the Australian bat workers had learned from the experiences of their American and European colleagues and so were careful to keep activities within these caves to a minimum, and partly because the uninformed were not aware of these caves or else found it too difficult to negotiate the approaches, which are often in areas with difficult access.

However, with the increase in leisure time available to many Australians, and also with the increase in the use of off-road vehicles, many of these caves are now being threatened with excessive disturbance caused by many people entering them. It is therefore becoming necessary for some of these caves to be protected so that such disturbance can be kept to a minimum.

The suggestions set out below are the results of visits to protected caves in West Germany and England. Hopefully on the basis of this paper Australian workers might formulate more comprehensive proposals. These could then be circulated to the various authorities which would then have a management programme based on the best available knowledge and experience.

The main aim of protecting a cave is to limit the access of humans without interfering with the air flow through the cave or without interfering with the free movement of bats in and out of the cave.

Ideally then, before any barrier is put across the opening the air movement of the cave and the general conditions within the cave should be recorded. The openings used by the bats for entry and exit and the methods by which they use these should also be documented. This may mean that observations will have to cover any opening likely to be used by humans for access into the cave.

Just what methods will be used to block the entrance to the cave will depend on what materials can be easily brought to that location and who is likely to carry out the work. Both of these will involve costs which in some caves might be quite appreciable. In all cases the decision on the type of covering to put across the opening would be based on factors which will allow the least disturbance to the bats and cost should be a secondary consideration. If there is insufficient money for the recommended system it may be better not to attempt to gate the cave but to wait until funds are available so that the job can be done properly. In the rush to protect bats from unwanted intrusions, inexperienced authorities have put up barriers which caused more bat deaths than had previously been caused by intruders (see also Tuttle, 1977; White & Seginak, 1987). Also a low cost job often looks amateurish and is therefore likely to encourage intruders to attempt to enter it whereas a professionally constructed barrier often convinces people that it is an official barrier and they are less likely to attempt to penetrate it.

As many caves are in rocky areas the ideal method in such places is to use 20-25 mm diameter round steel rods (EN 26 or equivalent) which are inserted into drilled holes on the side of the cave and which are spaced from centre to centre 170 mm apart thereby leaving horizontal gaps of 150 mm. The distance of 150 mm between the bars is small enough to prevent children putting their heads between the bars and so getting caught and yet wide enough to provide freedom of movement for the bats in and out of the cave. Somewhere in these horizontal bars there will need to be a gate. This should be the weakest point (as mentioned by several authors, e.g. Hunt & Stitt, 1975) of the design so that attempts to penetrate the barrier are made at this point which can be easily replaced. To support the door it will be necessary to have two vertical bars and again care should be exercised in positioning the door.

It will not always be possible to have only horizontal bars across the cave and so in large cave entrances it may be necessary to insert vertical bars which should never be closer together than 600 mm. Providing the steel is of sufficient strength it would be preferable to have these bars closer to 1 m apart. The ideal steel for these constructions are drilling rods which are used in mining and which are of high strength. In many of these the steel is treated so that it is partly crystallised and this makes it a very tedious process to cut through them. The vertical vars, if possible should be inserted in holes made in the rock of the roof and floor. In some caves it may not be possible to insert the ends of horizontal and vertical bars on each side into holes drilled in the rock. It may be necessary to chip some of the rock away and then to cement over the bars when they are inserted. This cement, if possible, should be put on the inside rather than the outside of the barrier. Similarly with the vertical bars it may be necessary to dig into the soil of the cave or into the rock on the floor of the cave and to imbed the bars in concrete. In all cases where concrete is used it should be moulded so that it comes as close as possible to the original contours of the cave entrance.

The horizontal and vertical bars will need to be welded together. The greater the distance between the vertical bars the greater the benefit to the bats, and also the less welding required. Holes are drilled into the rock on each side to insert them, and then welded to the vertical.

The door should be removable and not hinged. It only needs to be large enough for a person to crawl through and not to walk through. A frame is made for the door by placing two verticals close enough together and attached to these two horizontals which form the top and the bottom of the door. The bottom horizontal should be wide enough to allow the gate to sit on it, and extending horizontally from it into the cave is a lug with a hole in it so that the gate can be locked through this hole to the bottom of the door frame with a padlock. On each side of this horizontal lug should be a vertical lug which completely covers the lock so that it is not possible to insert a crowbar through the grille and break the lock. The lugs on the sides protect the padlock from being broken but allow a person to insert the key and thus open the door. The door is a square frame which can be made either of round steel or of angle iron with horizontal bars and with two lugs on the upper bar which insert behind the upper horizontal door frame and with a plate on the bottom side which allows the gate to be locked to the bottom horizontal lug of the door frame. If the frame itself is strong but the horizontal bars are made of angle iron, it is more likely that these will be attacked rather than the horizontal or vertical bars of the grille. Extra doors can be constructed so that they can easily be replaced while the damaged one is repaired. There is also less work involved in replacing the bars of the door than there is in replacing the horizontal bars of the grille.

It is very important when constructing this grille over the cave entrance that it is not all done in one day. As mentioned above the animals should be observed flying in and out of the cave before any attempt is made to grid the entrance. The construction of the grid should be in stages so that some of the entrance is blocked off and the bats' behaviour observed that night. If the animals show no disturbance to the flight patterns through the entrance, then construction is continued the next day. Again the bats are observed the following night and construction at each stage only proceeds if the bats are undisturbed by what has been constructed. Should the bats be disturbed by the construction then it should not proceed. If, after a few nights of this stopped construction, the bats still appear disturbed, it may be necessary to remove the partial construction.

It is extremely important to construct the grille in stages and to observe behaviour of the bats leaving the cave at night after each stage and not to proceed with construction should the bats show disturbed behaviour. Unfortunately in the past people have, with good intentions, constructed complete grilles in one day with disastrous results. It should be stressed that the grilles **must not** be constructed unless observations are made before, during and after construction.

Depending upon the nature of the cave entrance, the first stage may be inserting vertical bars at the edges of the entrance and then observing the vats' behaviour before then adding horizontal bars at the edges, and gradually extending the grille across the cave, leaving always the door open until the bats are flying either through the door or through the grille. The behaviour of the bats through the partial construction will often determine what part of the construction should next be completed. For example, if the whole grille is completed without disturbing the bats, and if we then find that the bats are flying only through the door which is still open and not through any part of the grille, they should be observed for several nights. If they continue to use **only** the door it may be necessary to remove parts of the grille and reconstruct rather than covering up the only exit being used.

It is important to remember that the grille is being put there for the protection of the bats, not for the exclusion of humans.

A professionally prepared sign explaining why the cave has been gated, and by which authority, will deter most intruders. Bat workers will need to liaise with the authority to ensure regular monitoring of the cave so that any damage to the barrier can be quickly repaired. As many caves are in remote areas this may mean that bat workers and the authority will need to enlist the support of local residents. An essential part of the protection is quick repair of any damage as this convinces intruders that they may be caught, especially if a fine is involved for unauthorised entry.

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WATER DITCHES INSTEAD OF GATES?

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Motto: 'A cave should be gated only as a last resort and when other methods of protection will not suffice.' (Powers, 1985).

As is well known (Powers, 1985, Tuttle, 1977), gating caves as a means of protecting bats is rather expensive. Apart from the initial costs, gate maintenance costs must be added: water is the enemy of gates (Powers, 1985). Unless they are carefully designed, gates can exert adverse effects on bat populations (Tuttle, 1977). Some European designs of gates are much simpler and cheaper as they consist only of horizontal bars (Roer, 1971). Nevertheless, they exhibit other imperfections of gates.

In view of the above it is surprising that - to the best of my knowledge - until now no water ditches have been put to the test in this respect. The installation of water ditches is not always feasible because of lack of nearby water. Sometimes, their costs could be even higher than those of a gate, should the rock be very tough. But in some cases one should consider undertaking trials as the presumed advantages of water ditches are as follows:

1) Generally, they promise to be substantially cheaper than gates,
2) They would not interfere with air circulation within the cave,
3) They would increase the humidity of air within the cave which is to the advantage of the bats,
4) They would constitute an obstacle for predatory mammals intruding into the caves to feed on bats where gates are no hindrance to such predators,
5) They could not serve as perches for owls which perch in the 'meshes' of the gate and prey upon bats in flight.

In only one respect the water ditches would perhaps be inferior to gates: they could be crossed in dinghies. Nevertheless, they would tremendously lower the numbers of unwanted visitors to caves.

In temperate latitudes the water ditches should be placed inside the cave far enough from the entrance to prevent their freezing over during the winter. Of course, some precautionary measures should be taken to prevent persons unaware of the water ditch from drowning.

Acknowledgement: Thanks are due to Mr Robert C. Currie (U.S. Fish and Wildlife Service) for providing me with advice and ample information.

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A COMPARISON OF TWO BANDING METHODS IN THE COMMON SHEATH-TAILED BAT, *TAPHOZOUS GEORGIANUS*

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Although banding of Australian bats has been carried out for the past 30 years (Purchase, 1985) there has been little serious study of the impact that bands have on bats. Problems have been recognised wit the traditional method of banding in some species but few innovations have been tried.

I commenced a study of the common sheath-tailed bat (*Taphozous georgianus*) in central Queensland in February 1985. A total of 685 bats were marked with size 4 aluminium bird bands which I initially closed over the propatagium and forearm in the traditional manner. I banded 236 bats in this way and subsequently recaptured 106 of these.

It soon became apparent that bands were causing damage to a high proportion of bats, either by constricting the propatagium in the mid forearm or by sliding distally to compress the forearm near the radio-carpal joint. In view of these problems, I was granted permission under the Australian Bat Banding Scheme to place bands over the forearm but through a small slit in the propatagium. In the sheath-tailed bat the propatagium is hardly visible in the flexed wing, but in full extension the edge of this membrane extends anteriorly by 3 to 4 mm. Banding through the propatagium avoided construction of this membrane and prevented the band from sliding distally. I banded a further 449 bats in this manner and subsequently recaptured 207 of these. Many bats were recaptured on multiple occasions and a total of 617 recaptures were recorded.

I weighed bats on capture and recapture and at recapture scored the amount of damage caused by the band. Damage scores conformed with the Australian Bat Banding Scheme damage scores where:

0 = No damage
1 = Minor abrasion or swelling
2 = Forearm swelling almost preventing movement
3 = Serious injury to the forearm, tissue growing around the band.

I tested statistical differences between means with Student's t-test and the relationship between banding method and damage score with the chi square test.

Table 1: The mean weight and standard deviation from the mean weight of recaptured adult bats with each damage score.

Damage score	0	1	2	3
Mean weight (g)	33.0	32.6	31.0	29.7
Standard deviation	5.3	5.0	4.2	3.4
Number of bats	220	214	122	61

There was significantly less forearm damage in bats banded through the propatagium than in bats banded around the propatagium ($x2 = 38.0$, $P \leq 0.01$) (Table 2).

Table 2: The percentage of bats with each damage score at the time of the first recapture.

Damage score	0	1	2	3
Banded around the propatagium (percent of 106 bats)	20	30	33	17
Banded through the propatagium (percentage of 207 bats)	41	41	12	6

When bands were placed around the propatagium, the number of bats suffering forearm damage increased with time. Forty percent of bats recaptured within 3 months of being banded in this way had unacceptable damage (score of 2 or 3), but this rose to 75% of bats recaptured more than 12 months after banding. In bats banded through a slit in the propatagium the number of bats suffering unacceptable damage did not increase, remaining at about 19% of the recaptured bats (Table 3).

Table 3: The change in the percentage of bats with a damage score of 2 or 3 on the first recapture in relation to the time the band had been in place.

Time since banding	1-3mo	4-12mo	>12mo
Banded around the propatagium			
Percent with score 2 or 3	40	61	75
Total caught	62	28	16
Banded through the propatagium			
Percent with score 2 or 3	15	23	19
Total caught	129	52	26

In the common sheath-tailed bat, the placement of a band through a slit in the propatagium is clearly superior to the traditional method of banding. Unfortunately, approximately 19% of bats banded in this way still suffer an unacceptable amount of forearm damage and I have now abandoned forearm banding in favour of bead-chain necklace banding. Bead-chain necklaces are expensive (about 29 cents for a sheath-tailed bat), but in preliminary trials there has been no damage and I have not been able to detect any adverse effects.

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OBSERVATIONS OF AN ASSISTED PARTURITION OF A GOULD'S WATTLED BAT, *CHALINOLOBUS GOULDII*

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There are few published observations of parturition in Australian microchiropterans. Those species for which parturition has been described include *Chalinolobus morio* (Young, 1979); *Eptesicus* sp. (Green, 1965) and *Nyctophilus geoffroyi* (Ryan, 1963; Green, 1966). Observations are presented here of an assisted parturition of a Gould's Wattled Bat, *Chalinolobus gouldii.*

On 10 November 1986 a female *C. gouldii* was found on the doorstep of a house in Templestowe, a suburb of Melbourne. When the bat was still present the following afternoon, the resident contacted the Arthur Rylah Institute. When collected, the animal was active, although not inclined to fly, and did not appear to have any external injuries. It was obviously heavily pregnant with twins, which could be readily palpated. The nipples appeared to have been used in the previous breeding season, but there was no recent nipple enlargement or development of the mammary glands indicative of imminent parturition.

The bat would not take any food or water, and the following evening began haemorrhaging from the vagina, with large blood clots remaining congealed on the vulva. These were gently removed as they formed. During this time it remained in a prone position on the floor of the box and did not use the provided roost. It was not observed at any stage to lick the genital region, as has been reported in normal births in some other species(e.g. Sherman, 1930; Ryan, 1963; Gopalakrishna and Madhavan, 1971).

On 14 November veterinary attention was obtained in an attempt to assist the birth. The bat was given subcutaneous injections of Hartmann's Solution (3 ml) - a sterile electrolyte used for rehydrating animals: Aminolyte 34X (Boehringer-Ingelheim) (0.1 ml) - a concentrated solution containing amino acids, electrolytes and B-vitamins; and Amoxycillin (5 mg) - a broad spectrum antibiotic. After four hours on a warm hot water bottle, it was found that parturition had commenced, with one hind foot and part of the leg of the foetus protruding. No contractions (as described in Wimsatt, 1960) were observed, and as the foetus was obviously dead (judging from the odour being emitted) the birth was assisted. The foetus was pulled gently from varying angles, and was delivered relatively easily, followed by some afterbirth. The young was estimated to have been dead at least one or two days. The left foot was delivered first, the right foot was tucked up under the chin and the body was in a very upright posture with the wings folded by the sides (see Fig. 1a). The ventral surface of the young was towards that of the mother. There was no attached umbilical cord.

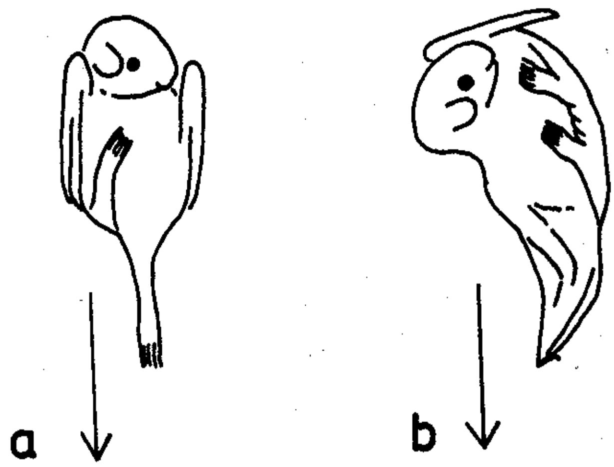

Figure 1. Orientation of *Chalinolobus gouldii* young at birth, of the first born (a), and the second born (b). Direction of delivery is indicated by the arrows.

During the delivery of the first foetus, the second moved to the centre of the female's body, presumably shifting from the uterine horn into the vagina. At this stage the female was given a subcutaneous injection of Oxytocin (1 I.U.), a uterus-stimulating hormone, to contract the uterus. Thirty minutes later the delivery of the second foetus began, this time a wing appearing first. As the female appeared unable to complete the delivery it was again assisted. This young was also dead, but did not smell as putrid as the first. The orientation of delivery was lateral (see Fig. 1b) with the right wing being delivered first. The rest of the body was compact with the feet tucked up towards the chin, and the head turned to the left with the left wing folded beneath it. The torso was twisted with the ribs pushed sideways.

The young appeared to be close to full term. They were darkly pigmented over most of the body, unfurred, mouth open, ears folded down, eyes relatively undeveloped, and feet and claws well developed. The humerus, radius and thumb were well developed, the fingers less so. Forearm lengths ranged from 13.0 - 14.0 mm, and varied between young and between forearms of the same individual. In south-west Western Australia, *C. gouldii* have been recorded as having forearm lengths of 14.7 mm (Kitchener, 1975). Head lengths of the two young were 13.0 and 12.3 mm. The level of development of these young appear to be similar to newborn *C. morio* described by Young (1979).

Later that night some afterbirth was removed and a final large piece was removed the next morning when a second injection of Oxytocin and a follow-up injection of the antibiotic Amoxycillin were administered. At this stage the female was extremely thin and dehydrated, and the fur dull and ungroomed. Later that day she became more interested in food and water, and was given a glucose and electrolyte mixture (Lectade; Beechams) orally using a syringe, and was fed the insides of mealworms.

Over the following weeks the bat gradually took more food and water (containing Lectade) and increased in weight. Water was taken freely after a week, but hand feeding was still required as it continued to take only the insides of mealworms (up to 50 a day), only rarely eating any of the exoskeleton. After about three weeks its body weight had returned to normal, and after some initial lack of control, it was flying competently. The condition of the fur returned to normal, except it started to loose fur on its throat. This was probably due to vitamin deficiencies resulting from the restricted mealworm diet (Hall, 1982). Pentavite multivitamin drops were then added to the diet, which appeared to prevent further hair loss. It was banded, and on 9 December 1986 was released at the site of initial discovery.

The reason for the difficulties experienced by this female *C. gouldii* are not known. Judging by the condition of the nipples it was not the first parturition, and its tooth wear indicated it was not particularly old. The orientation of the young, particularly the second one, may have caused problems, however, both foetuses had died before they had moved into a delivery position. It is not known whether, had the young been born alive, if the orientation of the foetus could have altered (e.g. in horses and cattle the orientation of the foetus rotates 180 degrees a few days before the birth).

Most general accounts of microchiropteran biology (e.g. Wimsatt, 1960; Hill and Smith, 1984) state that breech births are usual in vespertilionids (although it is not always clear if the feet are presented first, or the rump with the legs tucked up to the chest). However, there are published accounts of head presentation (see Wimsatt, 1960; Ryan, 1963), and lateral presentation. For example, Sherman (1930) reported on a birth of *Myotis austroriparius* in which the elbow was delivered first. This birth took more than 3.5 hours, which was considered abnormally long, although it is not known whether it was due to orientation of the young, or the weakened condition of the female. Gopalakrishna and Madhavan (1971) also reported a birth (of a *Pipistrellus ceylonicus*) in which the wing patagium of the foetus was presented first. This was the second foetus delivered, the first having been in the normal orientation and taking the standard 4.5 hours. Of five *Nyctophilus geoffroyi* births observed by Ryan (1963), two were twins and one was a single young. The single young was born head first. In one of the twin births the first young was born head first, followed by a breech presentation. In the second twin birth, the first young was also born head first, but for the second young, one knee appeared first followed by the rest of the leg, rump and folded wing. The other leg then emerged followed by the shoulders and head (Ryan 1963). This latter presentation was similar to that observed for the first *C. gouldii* young described above. It would appear that while breech births may be 'typical' for vespertilionids, there is obviously some variation in the orientation of a foetus at birth.

We would like to thank Andrew Bennett and Rob Warneke for comments on this note.

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WHERE IS THE TYPE LOCALITY OF *MACRODERMA GIGAS*?

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Dobson (1880) recorded the type locality of *Macroderma gigas* as 'Mount Margaret, Wilson's River, Central Queensland, Australia. (Captured by Mr Wilson). This speciment, sent by Dr Schuette to the Gottingen museum, is the same as that mentioned by Mr G. Krefft, C.M.Z.S., in a communication read before the Society in May 1879 (see P.Z.S. 1879, p.386). Bruck (1883) lists Rudolph Schuette, '16 College St., Sydney, N.S.W.: N.D. Gottingen (1865), L.S.A. London, 1866, Hon. Surg., St Vincent's Hospital, Sydney'. This would seem to be the Dr Schuette in question and since he graduated from Gottingen it seems likely that his specimen would have been sent to the Gottingen Museum. This specimen is now in the Bonn Museum (Mahoney & Walton, 1988).

St Vincent's Hospital Commemorative Centenary booklet (362. 1-5) mentions R. Schuette on the staff list in 1870 but not before this. It seems likely that the specimen was obtained by him some time between 1870 and 1879, or possibly between 1866 and 1879. In the report on Krefft's communication it was stated then that the speciment had lately been obtained in Queensland'. So it is likely that the specimen was obtained within a year or two of that date, possibly 1877 or 1878.

It has been assumed by most zoologists that the Mount Margaret refers to a pastoral property near Wilson River, a branch of Cooper Creek (approximately 26° 16' S and 143° 20' E). This pastoral property as well as the 'Mount Margaret' homestead (labelled Mt. Margaret St.?) and a Wilson River appear on a sketch map in the Mitchell Library of 'Warrigo and Gregory South districts, Queensland, 1882'. So it is likely that the locality and the river were known in 1877 or 1878. There were three Wilsons on the electoral rolls for the Division of Warrigo in 1875, one near Thargomindah and two near Cunnamulla. There appears to have been none on 'Mount Margaret'. It is thus possible that the type was collected here by a Mr Wilson.

However, no other specimens have been collected from this area and even in 1880 this area could not have been considered to be in Central Queensland as Hughes' (1884) School Atlas shows the present boundaries of Queensland so it is more likely that this area would have been considered in 1880 to be southern or far western or south western, rather than central Queensland. Further there has never been a mountain in this area named Margaret although there is one 60 kilometres north-east of the 'Mount Margaret' property on Wilson River.

In the original description it is 'Wilson's' rather than Wilson. This raises the slight possibility that it was a river known to the collector near a Mount Margaret and that at the time had no name. However the sketch map mentioned above does show the spellling 'Mount Margaret' for the area covering about 28 leases dating from 1870 to 1876, one from 1879 and one from 1880.

It is not clear who provided the locality details, but it is most likely that they were passed on by Dr. Schuette. It would be surprising if an educated person in 1880 considered the supposed type locality to be in Central Queensland and probably also unlikely that he would not have added 'homestead' or 'pastoral run' or 'Station' to 'Mount Margaret'.

All of the above raises the possibility that the type description may not be in this area but in some other area in Queensland. This is of some interest as this locality is far south of the present known range of the species.

In 1861, Landsborough named a Wilson Creek approximately 19° 4' S, 138° 50' E, branching off the Gregory River in northern Queensland. McKinlay named Mt Margaret earlier in the same year in this general area. Both locations are shown in Feeken and Feeken (1970) - (the reference number for Wilson Creek is 2847 and Mt Margaret 3035). These locations are in the general area of Mt Isa but are about 270 km apart. There is a Mt Margaret Homestead at 19° 22' S, 183° 51' E, close to Wilson Creek. These are approximately 35 km apart. These could not now be considered to be in central Queensland but it is possible that they might have been considered so by Dr Schuette in 1879, or by whoever gave the type locality. However, it is unlikely that Wilson 'Creek' would have been renamed in the description Wilson 'River'. If this were the 'Mount Margaret' referred to in Dobson it would be more likely that it would have been linked with the much larger and probably better known rivers at that time, such as either Flinders or Leichhardt River. There is a Williams River near this mountain and it is possible that it got confused with the collector's name and was unintentionally altered.

There is a Mt Margaret at 22° 51' S and 148° 39' E and a Wilson River at 21° 7' S and 147° 55' E. These are about 60 km apart, approximately 100 km to the north west and west of Mackay. This would have been considered both in 1880 and now as in Central Queensland. However, again, Wilson River is a rather small and insignificant river at some distance from the mountain so that Mt. Margaret would more likely have been associated with one of the larger rivers in the area, such as the Bowen. There were many visits to this general area by explorers and naturalists before 1880 but I have been unable to ascertain if Mt Margaret was known by 1880.

Similarly I have been unable to determine when the other seven Mt Margaret mountains in Queensland were named. None of these are near a Wilson River. Four of these (18° 25' S 144° 31' E; 18° 42' S 146° 14' E; 19° 04' S 144° 22' E; 19° 21' S 146° 36' E) occur within an area of 100 km west and 60 km north of Townsville, one (24° 50' S 150° 54' E) occurs near Monto, one (21° 25' S 144° 26' E) is near Hughenden, and one mentioned above (24° 28' S 144° 06' S) near Yaraka.

There is a need to determine if any of these mountains were known before 1880, and if there was a 'Wilson' or 'Wilson's' River nearby at that time. It may be that the name was not used later.

It is likely that the Cooper Creek-Wilson River area is the type locality. The doubt arises because this area in 1880, as now, could not be considered to be 'Central Queensland', and because there has never been a mountain in this area named 'Margaret'. The spelling 'Mount' may refer to a mountain or to the pastoral property known to exist in this area in 1880.

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AN ABBREVIATED CATALOGUE OF THE AUSTRALIAN BATS IN THE COLLECTIONS OF THE NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY, CALIFORNIA, USA.

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The Natural History Museum of Los Angeles County (LACM) is the repository for some 90,000 mammal specimens of world-wide provenance, and is particularly strong in its collections of Chiroptera. As the result of numerous collecting expeditions undertaken by one of us (KES) since 1954, a substantial representation of Australian bats has been assembled. It is our intent in this paper to bring these collections to the attention of our Australian colleagues, so that this biogeographic and systematic resource might be more widely used.

The following catalogue lists only species, sex, and locality for the bats currently in the collections. The majority of specimens are traditional study skins and skulls, but more recent additions include fluid preserved specimens, postcranial material, and frozen tissue. Taxonomy follows Honacki et al (1982) except for *Scoteanax* and *Scotorepens*, which follow Kitchener & Caputi (1985). Additional information on individual specimens, and the specimens themselves, may be examined by arrangement with the Assistant Curator of Mammals, Dr. Sarah George, at the institutional address.

Abbreviations: M (male), F (female), NSW (New South Wales), NT (Northern Territory), QLD (Queensland), TAS (Tasmania), VIC (Victoria), WA (Western Australia). N,S,E,W, (north, south, east, west, and combinations thereof).

PTEROPODIDAE

Dobsonia moluccensis.

6F, mouth of Pascoe River, Cape York Peninsula, QLD.

Macroglossus minimus.

5F, 2 km N of Mission Beach, QLD; 2F, 19 km NE Tully, QLD; 1M, mouth of Soda Creek, Wildman River, NT.

Nyctimene robinsoni.

4F, Gustav Creek, Nelly Bay, Magnetic Island, QLD; 1F, Cooktown, QLD; 5F, Iron Range, QLD; 1F, Julatten, QLD; 1?, Jack Gordon Mine at Claudie River, Iron Range, QLD.

Pteropus alecto.

1M,1F, 11 km W of Ayr, QLD; 4M,2F, Chevallum, near Palmwood, QLD; 4M, mouth of Elliot River, QLD; 1M,4F, Cockle Bay, Magnetic Island, QLD; 1M, Yaramulla Sta., 100 km SW of Mt. Garnet, QLD; 1M, 8 km S of Chillagoe, QLD; ??,??, mouth of Armstrong Creek, Cape Upstart, QLD; 1M,1F, mouth of Soda Creek, Wildman River, NT.

Pteropus conspicillatus.

1F, Mareeba, QLD; 3M, Iron Range, QLD; 4M, 2.5 km N of Mt. Molloy, QLD; 1M, 1F, Tolga, QLD.

Pteropus poliocephalus.

1?, Southport, QLD; 5M, 2F, 8 km S of Beenleigh, QLD; 1F, Norman Park, Brisbane, QLD.

Pteropus scapulatus.

3M,6F, 2.4 km N of Mt. Molloy, QLD; 1M, mouth of Elliot River, QLD; 2M,2F, Edith River, 33 km N and 12 km W of Katherine, NT.

Syconycteris australis.

4M, 1F, Woody Head, near Iluka, NSW; 4F, Gustav Creek, Nelly Bay, Magnetic Island, QLD; 2F, Stoney Creek, 32 km N of Yeppoon, QLD; 3M, 1F, Water Park Creek, 38 km N of Yeppoon, QLD; 2M, 3F, 1.5 km N of Mission Beach, QLD; 3M, 3 km E of Mt. Molloy, QLD; 2M, Iron Range, QLD; 4M, 2F, 20 km NE of Tully, QLD; 2?, Claudia River at Jack Gordon Mine, Iron Range, QLD.

MEGADERMATIDAE

Macroderma gigas.

1M, Ripon Hills, WA; 2M,2F, 1 km S of Pine Creek, NT; 1F, Mt. Wells Mine, Mt. Wells, NT.

EMBALLONURIDAE

Taphozous australis.

2M,3F, Douglas Hill, 40 km N of Townsville, QLD; 2F, Portland Roads, QLD; 1M, 1.5 km from mouth of Elliot River, QLD.

Taphozous georgianus.

1M, Coolabinna Pool, Villawarra Station, NWA (??); 3M, Olsen's Cave, nr. Mt. Etna, 28 km N of Rockhampton, QLD; ?5M,3F, Cave Rock, 5 km N of Roma Peak, 53 km SSW Bowen, QLD; 3M, 3F, Ryan Creek Cave, 13.5 km SW of Charter Towers, QLD; 2F, mine shaft 3 km NW of Croyden, QLD; 2M, Top Camp Diggings, Mary Douglas Hill, 42 km SSW of Cloncurry, QLD; 1M, Belfry Cave, 26 km N Rockhampton, QLD; 1F, 1 km S of Pine Creek, NT; 1M, 10 km E of Hayes Creek, NT; 1F, 7 km N and 15 km E of Tennant Creek, NT.

RHINOLOPHIDAE

Hipposideros ater.

4M,8F, cave at Bramston Beach, QLD; 5M, Top Camp Diggings, Mary Douglas Hill, 42 km SSW of Cloncurry, QLD; 2M,1F, 1 km S of Pine Creek, NT; 2M,3F, Mt. Wells, 35 km N and 12 km W of Pine Creek, NT;

Hipposideros diadema.

2M,3F, Ryan's Creek Cave, 10 km NW of Chillagoe, QLD; 1M, upper pool of Spring Creek, 9 km NW of Chillagoe, QLD; 2M,7F, Jack Gordon Mine, Iron Range, QLD.

Hipposideros galeritus.

7M,6F, Rothwell Mine, 6 km S of Coen, QLD; 1M,6F, Jack Gordon Mine, Iron Range, QLD.

Hipposideros semoni.

1F, 1km W of Jack Gordon Mine, Iron Range, QLD.

Hipposideros stenotis.

1F, 1 km S of Pine Creek, NT; 1M, Mt. Wells, 35 km N & 12 km E of Pine Creek, NT.
Rhinolophus megaphyllus.
1M,1F, Camp Mt., 6 km S Samford, QLD; 3M,1F, Pine Vale Mine, 16 km S Mirani, QLD; 1F, Ropeladder Cave, Fanning River Station, 29 km N Mingela, QLD; 3F, cave at Bramston Beach, QLD; 2M,1F, cave 4 km NW of Christmas Creek Station, 32 km SE Greenvale, QLD; 1M, stream crossing E of Kirrama Forest Camp, 32 km W of Kennedy, QLD; 1M,3F, Ryan Creek Cave, 10 km NW of Chillagoe, QLD; 1F, mine 2.5 km S of Mt. Molloy, QLD; 1M, Cooktown, QLD; 8M,11F, Rothwell Mine, 6 km S of Coen, QLD; 3M,5F, mine 5 km N of Mt. Molloy, QLD; 4M,1F lava tunnel on Yaramulla Station, 100 km SW of Mt. Garnet, QLD; 1M, mine at Paluma, QLD; 2M, 1? Jack Gordon Mine, Iron Range, QLD; 2M, mine at Cells Creek, 7 km SSE of Mt. Sea View, QLD; 1M, mine at Gold Creek, 5 km N of Kenmore, QLD; 6M, Haunted Cave, 13 km N of Chillagoe, QLD; 3M,3F, Mt. Molloy Copper Mine, Mt. Molloy, QLD; 1M, mine at Coen, QLD; 1M, 3 km N of Mt. Molloy, QLD; 2M,1F, Pigeon Gully, 10 km NW of Red Rock, NSW.
Rhinolophus phillipinensis.
1M,4F, mine 2.5 km S of Mt. Molloy, QLD; 1M, Walkunder Cave, Chillagoe, QLD; 1F, Jack Gordon Mine, Iron Range, QLD.
Rhinonicteris aurantius
4M, 1 km S of Pine Creek, NT; 3M, 2F, 1?, Spring Hill Mine, 8 km S, 4 km W of Mt. Wells, NT;

VESPERTILIONIDAE

Chalinolobus gouldii.
1F, 5 km E of Wallangarra, QLD; 1M, 13 km SE of Collarenebri, NSW; 1M, St. Kilda, VIC; 1m, Orbost, VIC; 1?, Norton's Farm, Corrigin, ?; 1M, QLD; 1M, NSW; 1M, locality unknown; 2M,1F, Coombadja Creek, Gibraltar Range, NSW; 1M,5F, Top Camp Diggings, 42 km SSW, Cloncurry, QLD; 2F, stock tank off highway, 88 km NW Mt. Isa, QLD.
Chalinolobus morio.
1M, Third Cave, Stockyard Gully, WA.
Chalinolobus nigrogriseus.
1F, 7 km NW of Chillagoe, QLD; 2M,1F, Fanning River Station, 29 km N of Mingela, QLD; 1F, 3 km N of Mt. Molloy, QLD; 3F, Wildman River, 48 km S, 20 km W of Pt. Stuart, NT; 1M, mouth of Gorge, Katherine River, NT; 1F, 2 km S of Mt. Wells, NT.
Eptesicus pumilus.
1M, Glenorchy, Tas; 1M, Lindeman Island, QLD; 2m,2F, Cave Rock, 5 km N of Roma Peak, 48 km SSW of Bowen, QLD; 1M, cave 4 km NW of Christmas Creek Station, QLD; 1F, sea cave at Douglas Hill, 4 km N of Townsville, QLD; 1M,5F, Ryan's Creek Cave, 10 km NW of Chillagoe, QLD; 1M, waterhole 7.2 km NW of Chillagoe, QLD; 1M, lava tunnel on Yaramulla Station, 100 km SW of Mt. Garnet, QLD; 6M, 16 km E of Georgetown, QLD; 2M, mine 3 km W of Croydon, QLD; 2M, mine in Mary Douglas Hill, 42 km SSW of Cloncurry, QLD; 1M, 32 km SSW of Cloncurry, QLD; 2M, 1F, 3 km N Mt. Molloy, QLD; 1F, Wildman River, 48 km S, 20 km W of Pt. Stuart, NT; 4M, 1F, 1 km S of Pine Creek, NT; 2F, 3M, 7 km N, 15 km E of Tennant Creek, NT.
Eptesicus sagittula.
2M, Cobcraft Creek, Werrikimbe National Park, Hastings Shire, NSW; 1M, Mt. Glorious, QLD.
Eptesicus vulturnus.
1F, 5 km E of Wallangarra, QLD.
Miniopterus australis.
4M,1F, 11 km W of Ayr, QLD; 1M,1F, The Caves, 26 km N of Rockhampton, QLD; 2M,2F, Douglas Hill, 4 km N of Townsville, QLD; 5M, Cangai Copper Mine, Cangai, NSW; 1M,3F, Gold Creek, 5 km S of Kenmore, QLD; 1M,1F, 12 km S of Kilkivan, QLD; 2F, Shamrock Mine, 11 km N of Biggenden, QLD; 1M, Boolboonda railroad tunnel, 20 km NE of Mt. Perry, QLD; 1M,2F, Stoney Creek Bat Cave, 32 km N of Yeppoon, QLD; 1M,1F,

Fanning River Station, 29 km N of Mingela, QLD; 2M,1F, Marble Creek, 32 km SE of Greenvale, QLD; 1M,1F, Gustav Creek, Nelly Bay, Magnetic Island, QLD; 1M, Kirrama Forest Camp, 32 km W of Kennedy, QLD; 1M, Haunted Cave, 9 km NW of Chillagoe, QLD; 2M,6F, lava tunnel, Yaramulla Station, 100 km SW of Mt. Garnet, QLD.

Miniopterus schreibersi.

7M,6F, 11 km W of Ayr, QLD; 2M, Coombadja Creek, Gibraltar Range, NSW; 5M, Cangai Copper Mine, Cangai, NSW; 1F, Gold Creek, 5 km N of Kenmore, QLD; 1M, mine, 11.8 km N of Kilkivan, QLD; 2M, Shamrock Mine, 11 km N of Biggenden, QLD; 1M, lime kiln, 22 km N of Biggenden, QLD; 2M, Boolboonda railroad tunnel, 19 km NE of Mt. Perry, QLD; 1M,2F, Marble Creek, 32 km SE of Greenvale, QLD; 1M,1F, cave at Bramston Beach, QLD; 2M1F, mine, 2.4 km S of Mt. Molloy, QLD; 1M, Rothwell Mine, 6 km S of Coen, QLD; 2M,4F, lava tunnel, Yaramulla Station, 100 km SW of Mt. Garnet, QLD; 1M,1F, Fanning River Station, 29 km N of Mingela, QLD; 1M, mine on Cells Creek, 7 km SSE of Mt. Sea View, NSW; 1M, mine, 12 km N of Kilkivan, QLD; 1M,1F, highway culvert, 13.5 km NE of Mt. Molloy, QLD; 2M,1F, Spring Hill Mine, 8 km S, 5.4 km W of Mt. Wells, NT.

Myotis adversus.

3M, 11 km W of Ayr, QLD; 3M,4F, railroad tunnel, 3 km NW of Sanford, QLD; 2M, culvert over Bluewater Creek, 8 km W of Cardwell, QLD; 1M, culvert under highway, Bingil Bay, QLD; 1?, Kirrama Forest Camp, 32 km W of Kennedy, QLD; 1F, Enogerra Creek, Brisbane, QLD; 1M,3F, mouth of Gorge, Katherine River, NT.

Scotorepens balstoni.

1M,2F, Gustav Creek, Nelly Bay, Magnetic Island, QLD; 2M, 1F, 8.8 km NW of Chillagoe, QLD; 1F, Fanning River Station, 29 km N of Mingela, QLD.

Scotorepens greyi.

2F, Southport, QLD; 2M,1F, Marble Creek, 32 km SE of Greenvale, QLD; 3M,5F, Top Camp Diggings, 42 km SSW of Cloncurry, QLD; 1M,1F, stocktank off highway, 88 km NW of Mt. Isa, QLD; 2F, Enogerra Creek, Brisbane, QLD; 3M,3F, Wildman River, 48 km S, 20 km W of Pt. Stuart, NT; 1F, 6 km NE of Pine Creek; 2M,2F, mouth of Gorge, Katherine River, NT.

Scotorepens influatus

1M,1F, Top Camp Diggings, 42 km SSW of Cloncurry, QLD.

Scoteanax rueppellii

1M, National Park Headquarters, Gibraltar Range, NSW; 1M, Coombadja Creek, Gibraltar Range, NSW; 1M,1F, Moorabark, Werrikimbe National Park, NSW.

Nyctophilus arnhemensis.

3M,3F, Wildman River, 48 km S , 20 km W of Pt. Stuart, NT.

Nyctophilus bifax.

1M,1F, Cooktown, QLD; 1M,1F, 7 km NW of Chillagoe, QLD; 1F, 3km E of Mt. Molloy, QLD; 3M, Rifle Creek, 3 km N of Mt. Molloy, QLD; 1M,1F, Hann River crossing, 60 km S of Musgrave, QLD; 1M, 2 km N of Mt. Molloy, QLD.

Nyctophilus geoffroyi.

2M, Mandura Millamolong, NSW; 1M, Fanning River Station, 29 km N of Mingela, QLD; 1?, Orbost, VIC.

Nyctophilus gouldi.

1F, Coombadja Creek, Gibraltar Range, NSW; 1F, Morrabark, Werrikimbe National Park, NSW; 2M, Cobcraft Creek, Werrikimbe National Park, NSW; 1M, 18.75 km N of Dorrigo, NSW; 1F, 26 km N, 2 km E of Dorrigo, NSW; 1M, Mt. Glorious Rainforest, QLD; 1M, Enoggera Creek, Brisbane, QLD.

Nyctophilus walkeri.

2M, mouth of Soda Creek, Wildman River, NT; 1M, 2 km S of Mt. Wells, NT.

MOLOSSIDAE

Mormopterus beccarii.

1M, 4F, Tully, QLD; 3M, stockwater tank off highway, 88 km NW Mt. Isa, QLD.

Mormopterus loriae.
2M, Enoggera Creek, Brisbane, QLD.
Mormopterus planiceps.
1M, Red Cliffs, Brazenor, VIC.
Tadarida australis
1M, Costerfield, Vic.

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NOTICES

First National Flying Fox Symposium

Copies of the papers presented at the symposium held in Brisbane in August 1986 have been bound into a booklet. There are 24 papers which cover all aspects of flying fox biology from identification, movements, physiology to crop protection and management. The booklet contains 80 typeset pages.

The price of one or less than ten copies is $6.00 each. For 10 or more copies the price is $4.50 per copy. Please add postage costs: $1.65, (Queensland); $2.10, (Australia); $1.85, (Overseas surface mail); $6.60, (Surface air lifted). Make cheques/ money orders payable to: 'Australian Mammal Society Flying Fox Symposium' and send to:

Dr Les Hall
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Australia.

Flying Fox Bibliography Available

Fruit Bats (Megachiroptera) of the World: A Bibliography was recently completed by the Institute of Pacific Islands Forestry in Honolulu, Hawaii. The bibliography is limited to bats of the suborder Megachiroptera and was compiled mainly from a search of computerised databases, but also includes older literature selected from references cited in documents in the Institute's collection. It contains a general alphabetical listing and cross-referenced subject index. The 38-page bibliography is available free of charge from: United States Department of Agriculture, Institute of Pacific Islands Forestry, 1151 Punchbowl Street, Rm.323, Honolulu, Hi 96813.

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INSTRUCTIONS TO AUTHORS

Manuscripts plus two copies, complete with illustrations and tables, should be submitted to the Editor, Macroderma, PO Box 859 Civic Square, ACT 2608.

MS should be in clear concise English and typed with double spacing on A4 paper. **If manuscripts can be provided on computer disc please indicate this when submitting material for publication.**

Papers should consist of: title; names and addresses of authors; abstract of not more than 200 words; introduction; materials and methods; discussion or the latter two combined. References should conform to the World List of Scientific Periodicals, 4th Edition and references in the text should conform to the format used in this issue.

All pages, figures and tables should be consecutively numbered and the correct orientation shown on figures. Metric units should be used throughout. Camera ready copy is desirable for diagrams, but they should, at least, be submitted in black on a white background. Black and white photographs may be used. Tables should be in a format suitable for reproduction on a single page of the journal.

Common names, where used, should conform with the recommendations of the Australian Mammal Society (Bull. Aust. Mammal. Soc. 6: 13-23).

Short communications should meet the requirements for paper, except that subheadings other than title, names and addressed of authors and references should not be used. Short communications should not exceed five double spaced typed A4 pages.

Manuscripts are not being routinely refereed at this stage, although editorial amendments may be suggested. Specialist opinion may be sought in some cases.

Notices may be in any format, but clear and concise English should be used.