

THE GHOST BAT:

reclusive and vulnerable



G. B. Baker

Researchers are at last getting to know this 'gentle giant' among carnivorous bats

Imagine a predator so powerful and formidably armed it can kill and eat creatures weighing as much as itself, and so superbly evolved it hunts by sight, by sound and by echo-location. It may sound like something out of a science-fiction horror movie, but such a predator exists — and it has an incongruous reputation for gentleness and shyness.

Weighing up to 150 grams and with a 60-cm wingspan, the ghost bat, *Macroderma gigas*, is the world's second-largest microchiropteran, exceeded only in size by a South American carnivorous bat, *Vampyrum spectrum*. (Australia's 60 species of carnivorous and insectivorous bats belong to the suborder Microchiroptera; our eight or so species of fruit bats, which can attain a wingspan of more than a metre, belong to the suborder Megachiroptera). Formerly distributed across much of mainland Australia, the ghost bat is now only found north of the Tropic of Capricorn and — with a population, at the most generous estimates, of no more than 7000 individuals — is classified as a vulnerable species in the International Union for the Conservation of Nature's *Red Data Book*.

Bats rarely hit the headlines: as Mr Greg Richards of CSIRO's Division of Wildlife and Ecology admits, bats are harder to 'sell' to the public than more immediately appealing mammals such as koalas, numbats or kangaroos. However,

Ghost bats, Australia's largest microchiropterans, are fearsome predators, capable of capturing animals weighing almost as much as themselves. They are, however, timid and inoffensive creatures, increasingly rare throughout their shrinking range.



One of Australia's handsomest bats, the ghost bat has a leaf-like projection on the nose that aids in echo-location. The large eyes and sensitive ears enable this species to hunt using sight and sound as well as biosonar.

ghost bats fluttered into public awareness in Queensland recently, when one of their few roosting and breeding sites was destroyed... for the sake of cement. This act (carried out despite widespread opposition from zoologists and conservation organisations) might have reduced the species' chances of survival, but it did make Australians more aware of one of the continent's handsomest, most unusual and least-known native mammals.

The ghost bat's very shyness and sensitivity to disturbance have made it difficult for zoologists to learn intimate details of its life: we know far less about it than, say, the common bent-wing bat (*Miniopterus schreibersii*), despite its far greater size — an adult common bentwing, with a wingspan of about 12 cm, weighs only some 40 grams — its pleasant and accessible 'personality' and its ability to kill and eat almost any animal smaller than itself.

Our lack of information on the biology of the ghost bat actually poses a potential threat to its survival; the less we know about an animal, the less we can be sure that we are applying the right strategies for its conservation. To overcome that lack, Mr Richards joined a multi-disciplinary team of ecologists, ethologists, physiologists and biophysicists from the Australian and New South Wales National Parks and Wildlife Services, from the Royal Australian Ornithological Union and from several Australian universities to study a ghost bat roost at Pine Creek, about 200 km south-east of Darwin in the Northern Territory.

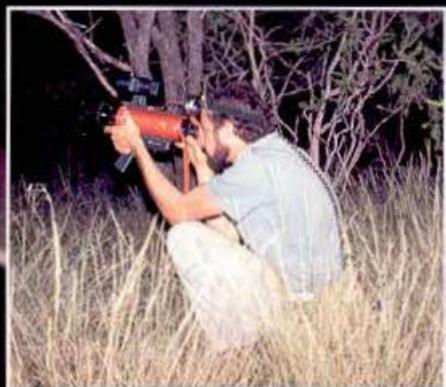
After establishing a base camp close to a disused gold-mine complex at Pine Creek, the team erected three radio-receiver towers to track the nightly foraging movements of ghost bats. They then estimated the number of individuals in the colony,

monitoring most of the exits and using dim lights to count bats leaving the mine. The result was a total of 445 adult bats, which must be regarded as a conservative estimate — not all exits could be observed, and the species' sensitivity to disturbance might have prevented some bats leaving the roost during the observation period — but one that marks Pine Creek as the largest single ghost bat colony yet discovered.

Next the researchers began observations of foraging bats outside the mine entrances and of roosting bats within the mine itself — an often unpleasant task (bat colonies attract a varied fauna of parasites and scavengers, including cockroaches, spiders and centipedes, although the cane toads often found in bat caves were luckily absent from Pine Creek), and one that involves long, boring hours of quiet watching in dim light and listening for bats' vocalisations and echo-location signals.



A scientist attaches a radio transmitter to a ghost bat as part of the first intensive study of this little-known species' biology. A quick-setting adhesive is used to attach the transmitter, which operates continuously for several days. Constant grooming by the bat gradually loosens the transmitter until it falls off.



Researcher Mr Greg Richards uses a night scope to observe hunting ghost bats. Visual tracking and radio-transmitters enabled the Pine Creek research team to add a great deal to our knowledge of ghost bat biology.

Inside the mine, researchers observed ghost bats pursuing a quail (unsuccessfully) and catching dusky horseshoe bats (*Hipposideros ater*), which appear to be favoured food items since they will retreat into cave passages too small for ghost bats when these predators are in the vicinity.

Although observations of hunting behaviour and inspection of debris at the bases of night-roost trees revealed that ghost bats ate mainly scarab beetles and the yellow-winged locust (*Gastrimargus musicus*), many vertebrates are included in the diet: at Pine Creek these include finches, owlet-nightjars, black-faced and white-breasted wood swallows, peaceful doves, red-backed wrens, brown honeyeaters, hooded parrots... even sacred kingfishers. As well, remains of marsupial mice (*Sminthopsis butleri*), native rodents (*Pseudomys* spp.) and lizards were found in caverns used as day roosts.

Scratches found on the trunks of *Eucalyptus alba* trees in the Pine Creek area turned out to have been made by ghost bats: captive bats were observed to drag their prey up tree trunks (to a height of between 1 m and 3 m above ground) for consumption.

The researchers attached radio transmitters to 12 free-ranging ghost bats that had been captured in mist nets, and tracked the bats' foraging behaviour over five successive nights. Triangulation of the bats' movements from three tracking stations revealed that individual bats use preferred specific foraging areas, most of which were located 1-2 km from the mine and covered an average of 60 hectares.

Following the evening exodus most bats flew quickly to their foraging areas, where they engaged in an initial period of hunting activity lasting 1-3 hours. This was usually followed by an hour or so of rest, then a second foraging period lasting 3-4

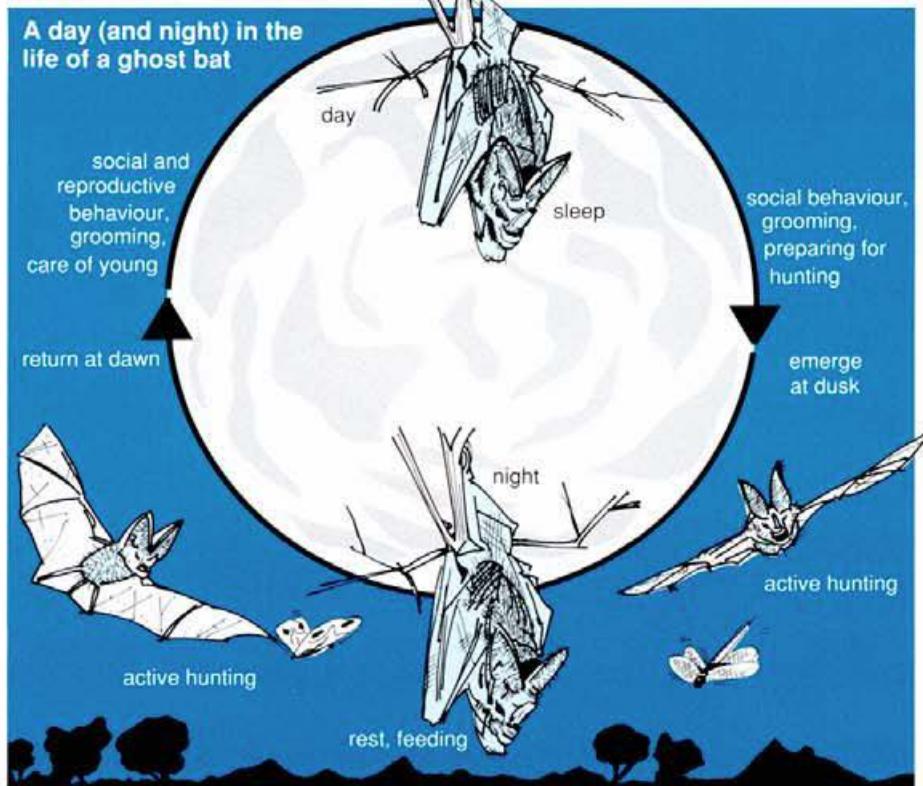
hours until the bats returned to the mine shortly before dawn.

In contrast to many other micro-chiropterans, ghost bats are highly conversational, employing four main types of vocalisations audible to humans (that is, between 20 and 20 000 hertz, or cycles per second).

- A bird-like 'twitter' — described as similar to the sound made when two coins are rubbed together — is the most common vocalisation used inside day-roosting caverns, and occurs particularly frequently close to the time of the evening exodus.

- A 'squabble' call is most often heard when individuals fight over food

Photos: G.B. Baker



Bats wake around sunset and leave the roost at dusk. They forage for insects and other prey, then rest for 3–4 hours before resuming hunting; they may return to a feeding roost or bring prey to near the entrance of the sleeping roost for consumption. Around dawn they return to the roost.

or a resting place, or when they touch accidentally as they land.

- A 'chirp' call, reminiscent of bird or cricket song, is heard often, both within roosting caverns and when bats are foraging in the open at night. An untrained observer may confuse the chirp with that of nocturnal grasshoppers, but once recognised it is one of the easiest ways of tracking ghost bats as they forage. The chirp also seems to play a role in the assembly of bats within the cavern prior to the evening exodus, apparently as a contact. At Pine Creek, a few bats hang just inside the mineshaft entrance and chirp frequently, their calls being answered by bats deep within the mine and by 'early risers' hanging in trees outside the mine entrance.

- A 'distress' call, similar to a rabbit's distress squeal, has proved easy to imitate and very effective in attracting bats, which approach observers to investigate.

Ultrasonic vocalisations are very brief (about one-thousandth of a second in duration) and relatively low in intensity, and appear to be useful only over several metres; researchers found it necessary to place ultrasonic microphones immediately above mine exits, since microphones only 5–7 m away from the exits yielded very poor, if any, recordings of biosonar. Most microchiropteran echo-location or biosonar impulses, which range in

frequency from 5 to 200 kilohertz, can be detected at a distance of 30 m or more, indicating that ghost bats use biosonar only for complex navigation or for close-range hunting.

While the species uses echo-location to capture large flying insects 2–3 m above the ground, with impulses rising in intensity and frequency just before contact with prey (in a 'terminal buzz'), its responsiveness to imitations of the distress call and its habit of using 'gliding attacks' that do not employ biosonar confirm that it can and does use sight and hearing to locate, pursue and capture prey.

Seasons north of the Tropic of Capricorn are less marked than in more temperate southern regions and the ghost bat's reproductive cycle remains constant throughout its range. Reproductively active animals converge on suitable caves and mines during April and May. (The species' preferences include a mean mid-winter temperature of more than 25°C and relative humidity of 60–70%; multiple entrances; and tight, restricted chambers with few

draughts.) The males' testicles become enlarged at this time, and they are markedly more aggressive towards each other.

After mating the bats disperse, individuals or small groups of animals moving around in response to changes in food availability. In the past this phenomenon resulted in over-estimates of populations: only recently has the use of radio transmitters revealed that a relatively small population from one locality can disperse 200 km or more.

Gestation lasts 11–12 weeks; depending on location, a single young is born between August and October, and observations of captive ghost bats at Taronga Zoo, Sydney, suggest that infants stay with their mothers for at least 5 months.

Ghost bats seem to be more responsive to disturbance towards the edges of each population's range, although researchers at the established maternity roost at Pine Creek noted that rifle fire not associated with the expedition was enough to drive two specimens several kilometres from their preferred foraging areas, and that the approach of a vehicle or an unwary human usually led to a bat's departure.

The tragedy is that the studies that have told us what little we know about the ghost bat were inspired by the species' increasing rarity, as well as by the risk that, unless we can learn more about its biology, we may soon see it disappear altogether. A century ago ghost bats could be found throughout much of northern mainland Australia, but it seems their shyness and inability to cope with the advance of human settlement have pushed them further and further away from people... and possibly towards extinction.



Examination of scats beneath eucalypts in the Pine Creek area revealed that ghost bats eat primarily scarab beetles and grasshoppers, though they also hunt frogs, reptiles, small mammals and birds.



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Despite its fearsome dentition and powerful jaws, the ghost bat is remarkable for its tame disposition; it rarely attempts to bite, unlike smaller and less well-armed insectivorous bats.

Ghost bats can now be found only in seven confirmed and three probable widely scattered populations: in Queensland, around Rockhampton, Cape Hillsborough, Chillagoe and Camooweal and possibly Cape York; in the Northern Territory around Pine Creek and possibly in Arnhem land; and in Western Australia in the Kimberleys and the Pilbara and possibly at Kalumburu Mission in the far north of the State (see the map).

As mentioned above, uncertainty over the species' conservation status has been fuelled by its habit of dispersing during the dry season. This has led some observers to assume ghost bats are more abundant than intensive surveys have revealed. In fact, probably no more than 7000 individuals survive: a maximum of 600 in Queensland, between 3000 and 5000 in the Northern Territory and as few as 1000 in Western Australia, though there may be other, as yet undiscovered, populations in Western Australia's rugged wilderness areas.

In 1990, Mr Richards and other ghost bat researchers met at the Australian National Parks and Wildlife Service's Canberra headquarters to pool their knowledge of the species and to assess strategies for its conservation and management. The meeting was inspired by concern expressed at the Eighth International Bat Conference, held in 1989 under the auspices of the IUCN Species Survival Committee, over events such as the destruction of ghost bat maternity caves at Mount Etna, Qld, to obtain limestone for making cement.

The ghost bat conservation and management meeting reviewed available information on the species' biology and status, and noted the following threats to its survival:

- only 20% of known maternity sites are within reserves or protected areas

(those at Camooweal and Pine Creek and in Western Australia have no firm protection from human impact)

- progressive population reduction is fragmenting and genetically isolating ghost bat populations
- some colonies, especially that at Pine Creek, NT, occupy sites that are liable to collapse in the near future — possibly destroying one-quarter of the species' entire population
- ghost bats are especially vulnerable to impact from mining or uncontrolled tourism
- since ghost bats are known to hunt frogs, they may be at risk from the continued spread of cane toads throughout northern Australia
- in farming areas, ghost bats may be vulnerable to the effects of accumulations of agricultural pesticides
- the species' resistance to diseases, especially introduced diseases or those that could be exacerbated by stress, is unknown
- long-term climatic changes could adversely affect its distribution, since it has precise microclimatic needs.

The meeting recommended that the Queensland, Western Australian and Northern Territory governments officially recognise ghost bats as being endangered and give their breed-

ing sites immediate protection; that populations be surveyed and population-monitoring programs introduced; that colonies be protected from disturbance and that potential sources of threats to colonies, such as mining companies, should be invited to play a part in the long-term management of the species. Ghost bats are now protected in every State and have recently been classified by the Council of Nature Conservation Ministers as vulnerable.

Mr Richards's concern over the public image of bats was reflected in the meeting's recommendation that education programs be developed to improve public awareness of bats in general and of ghost bats in particular. Few Australians realise, for example, that insect-eating bats consume up to half their own body weight in insects every night, which gives them an important role in controlling insect pests. This means an 'average' colony of 100 000 insectivorous bats, each weighing 20 g, will eat 365 tonnes of insects a year — the ultimate in biological pest control!

Carson Creagh

More about the topic

The Australian Ghost Bat, *Macroderma gigas*, at Pine Creek, Northern Territory. J. Pettigrew, G.B. Baker, D. Baker-Gabb, G. Baverstock, R. Coles, L. Conole, S. Churchill, K. Fitzherbert, A. Guppy, L. Hall, P. Helman, J. Nelson, D. Priddel, I. Pulsford, G. Richards, M. Schulz and C.R. Tidemann. *Macroderma*, 1986, 2, 8-19.

'Priorities for Ghost Bat (*Macroderma gigas*) Conservation and Management.' W.R. Phillips. (Australian National Parks and Wildlife Service: Canberra 1990.)

Echoes in the dark. W.R. Phillips. *Geo*, 1988, 10, 96-113.

Discrete populations of ghost bats are now restricted to relatively remote areas of northern Australia. Each population has a home range extending about 200 kilometres; winter dispersal throughout these ranges has led some researchers to conclude that populations are larger than more intensive surveys have revealed.

