BATS – A PART OF OUR HERITAGE

By N. L. McKenzie, Western Australian Wildlife Research Centre

▲ A typical insectivorous bat in flight. Gould's Wattled Bat *Chalinolobus gouldii* is one of about nine species of bat occuring in the south-west of Western Australia. Photo copyright A.G. Wells.

It is amazing how many people think of a bat only in terms of a furry thing that flies at night and spends the rest of its time hanging upside down in a cave somewhere. Legend also associates them with vampires and creepy-crawly things that get tangled in your hair.

In this abstract way, bats are much maligned whereas, in fact, they are mostly harmless little mammals so highly specialised that they were able to achieve mastery of the air long before prehistoric man walked upright.

Biologists include all bats in the taxonomic order Chiroptera which means hand-wing. But if you look more closely at the group a great array of differences between species becomes apparent. They range from species with bodies as large as a rabbit with a wing span of over a metre to those, smaller than a mouse, that have a wingspan about the size of a human hand.

In terms of species richness, bats are the second largest group of mammals; about 900 species are known worldwide. On warm, moonless summer evenings multitudes of bats can usually be seen coming to drink at farm dams. They are probably the most abundant group of mammals in the temperate and tropical zones of the world but few have colonised the sub-arctic and arctic regions (for reasons that will be discussed later) even though their ability to fly makes them one of the most mobile groups of animals on Earth. Aside from insects and birds they are the only animal group capable of sustained powered flight.

Bats are thought to have evolved about 50 million years ago, in tropical forests of the early Eocene, from a tree-dwelling insectivorous ancestor. The complex dentition of the more primitive groups of bats support this theory although species have since radiated into a wide variety of niches. Today, the Chiroptera includes species that feed on fruit, nectar, insects, arachnids, fish, crustacea, mammals, birds and reptiles. Such 'trophic' radiation has been associated with wide adaptation and specializations involving all aspects of bat physiology and anatomy.

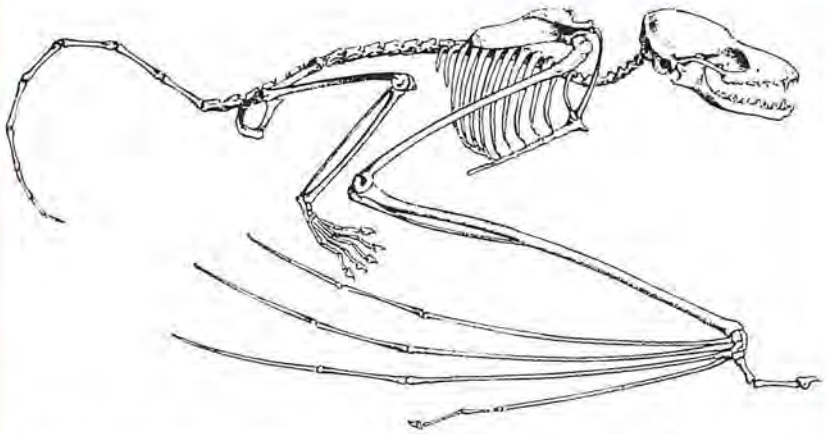
There was never really a first bat. It is just an arbitrarily defined section of the vast family tree stretching back in time to the first molecule of genetic material. Details of the evolution of bats are vague. Their very fragile bones do not fossilize well and, in any case, conditions in the tropical and sub-tropical areas where they are thought to have evolved are not favourable for fossilization. The very earliest fossil bats known (e.g. *Icaronycteris index* from lake sediments in Wyoming) had already evolved to almost their present state.

At that time the ancestors of modern horses were the size of dogs and humankind were just small monkeys "Bats were bats when men were lemuroids or less, and the family trees of the two groups...since dinosaur days, have grown tall side by side, in the same general ecological grove, to lofty branches of mammalian specialization: bats echo-locate and fly, men think and fly" (Jepsen).

Other animals have evolved flight; in vertebrate animals alone, flight was adopted as a means of locomotion wholly independently by reptiles, birds and bats. Although they all invented wings, the designs were different in each case. For bats, the anatomical and behavioural commitments associated with flight have cast them into a mould so alien to man's way that we have difficulty assigning them an anthropomorphic (man-like) image such as the cute and cuddly Koala Bear, Big Bird, Mickey Mouse and Donald Duck. Consider instead the leathery wings of the devil and Stoker's description of Dracula, climbing about on his castle wall "...but my feelings turned to repulsion and terror when I saw the whole man slowly emerge from the window and begin to crawl down the castle wall over that fearful abyss, face down with his cloak spreading out around him like great wings".

Bearing in mind that the vampire bats of Central America are also carriers of rabies, the Mayan worship of a blood-sucking god and the Aztec bat deities are hardly surprising. The European association of bats and supernatural happenings was transformed into a vampire craze in the 1730s after Cortes and his followers had discovered the vampire bat in the New World. A fragment of reality compounding superstition.

The Chiropteran way of life is committed to nocturnal activity, for only at night can their problems of moisture and temperature control be overcome. This strategy also determines their day-time refuges in the sombre depths of caves, hollow trees or dense foliage. They even feel different if touched; the oily skin of their wings is a prerequisite for temperature maintenance and moisture conservation in flight for these relatively small homeotherm animals that expose vast areas of skin to the air flow. Part of flying at night is the ability to see in the dark. In this regard, bats often have incredible sensory systems involving complex facial structures for sending and receiving high frequency sonar impulses. General ignorance of the factors which determine the behaviour and appearance of bats inevitably led humans to feelings of aversion and to dark superstitions.



Reconstruction of the skeleton, skull and teeth of *Icaronycteris index*, the earliest known fossil bat.

Bats are perhaps the most gregarious of all mammals. Single breeding colonies of the Bent-wing Bat *(Miniopterus schreibersii)* have been estimated at 44 000 individuals, but these are mere villages compared with the summer colonies of *Tadarida brasiliensis*, an American free-tailed bat known as the Guano Bat. An expanding cloud of *Tadarida brasiliensis*, 33 kilometres in diameter, was detected on radar in Texas, U.S.A. near Bracken Cave, a known breeding cave. In August up to forty million individuals occupy this cave. Camps of flying foxes in Australia comprise up to half a million individuals. In contrast, other species are near solitary, occuring in ones and twos in their roosts.

The Chiroptera fall in two natural sub-orders: the Microchiroptera, most of which are insectivorous, and the Megachiroptera or fruit bats, the larger of which are known as flying foxes.

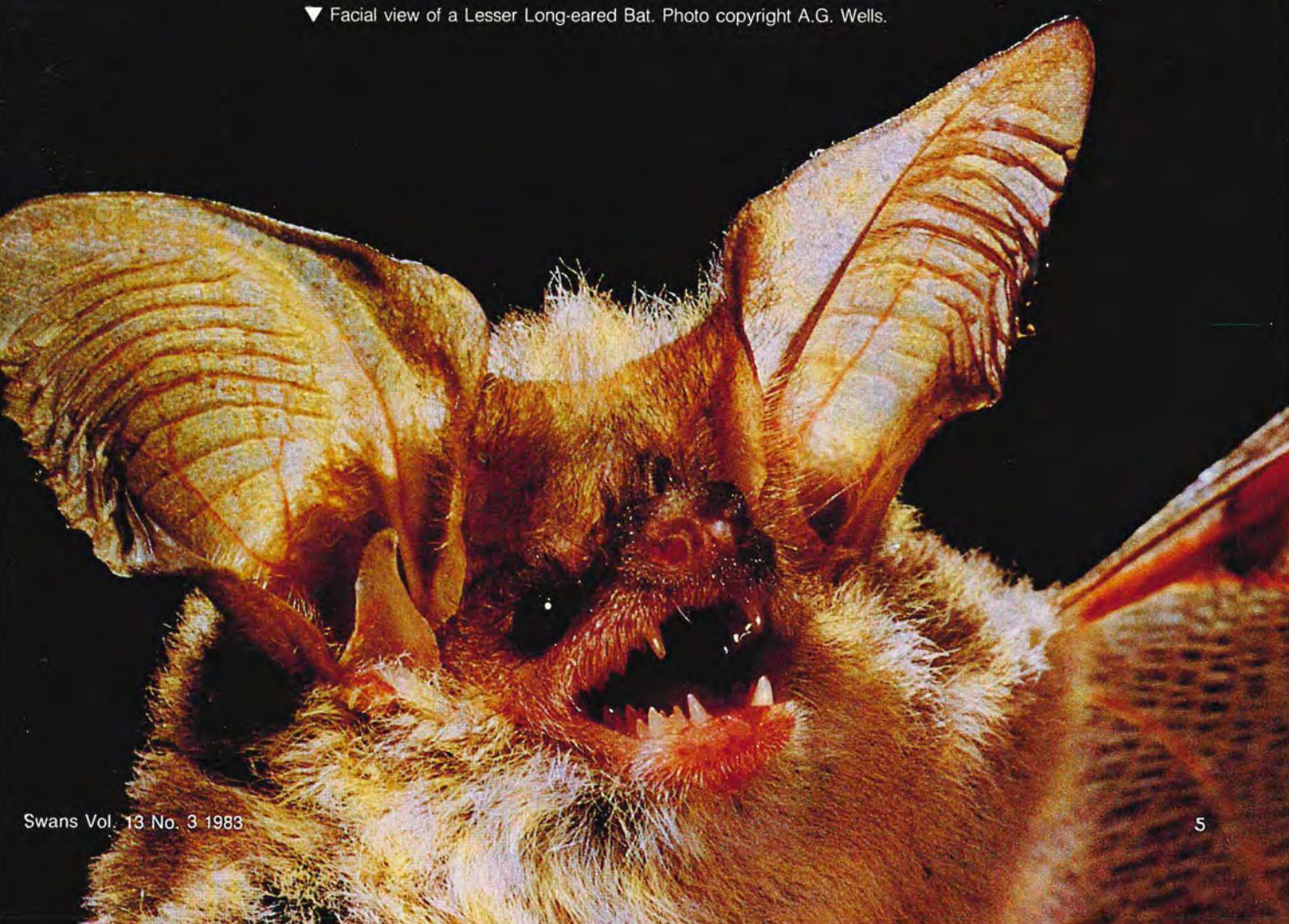
Megachiroptera

The Megachiroptera are generally larger in size and, with the exception of one genus which developed a form of its own, they do not use echo-location. Instead, their eyes are comparatively large and their skin incredibly tough so that collisions with vegetation seldom result in tears or impalement. They roost with their wings folded around them like a cloak.

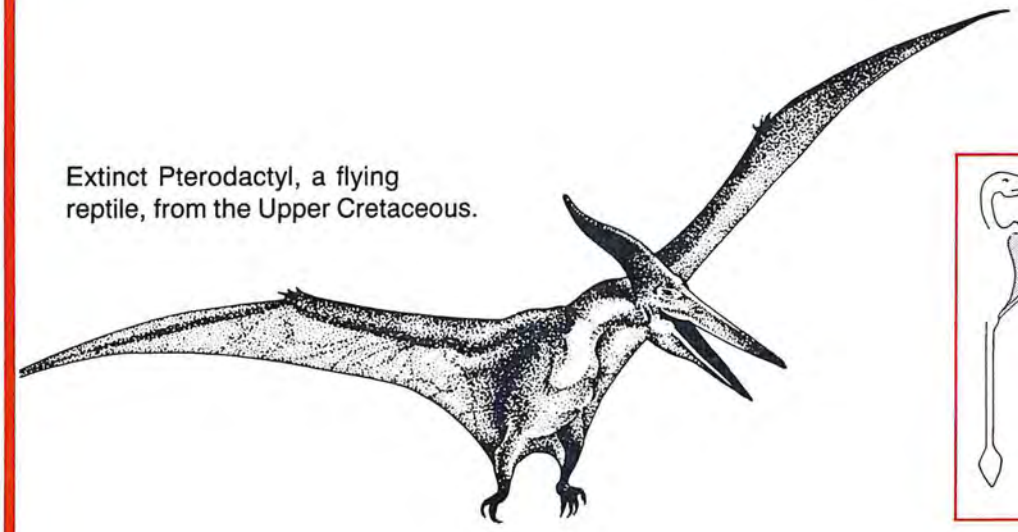
The larger fruit-eating members of the Megachiroptera can be very destructive, visiting domestic gardens and plantations up to 80 kilometres away in ravaging hordes, night after night. The CSIRO began a study of flying foxes as pests in Queensland and New South Wales in 1929. They found that broad scale control measures were economically impractical. Shooting, poison gas, explosives, flame guns and poisoning in orchards were all assessed as options. Flying foxes were shown to be mainly blossom feeders and not a serious menace to commercial fruit ventures although occasional large losses of soft fruit such as figs, peaches and especially mangoes were reported.

▲ Red Flying Fox. Photo copyright A.G. Wells.

▼ Facial view of a Lesser Long-eared Bat. Photo copyright A.G. Wells.

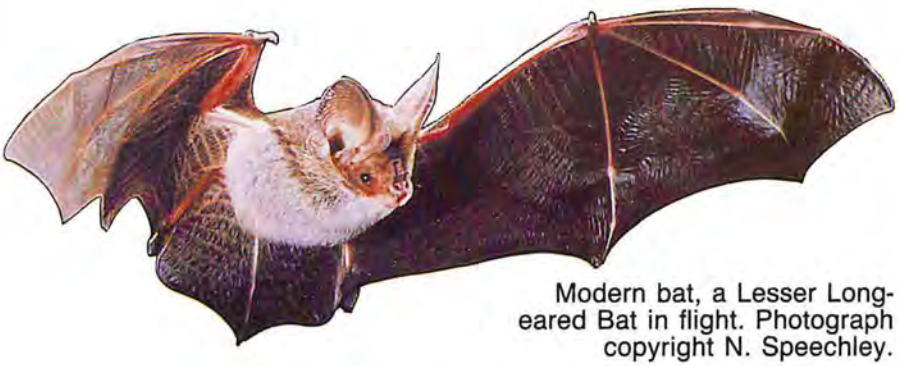


THE MECHANICS OF FLIGHT
— BIRDS, BATS AND REPTILES



Extinct Pterodactyl, a flying reptile, from the Upper Cretaceous.

Modern bird, Osprey in flight. Photograph copyright A.G. Wells.



Modern bat, a Lesser Long-eared Bat in flight. Photograph copyright N. Speechley.

There have been recent complaints about flying foxes damaging mango crops at Kununurra, Western Australia. This problem can be alleviated with sensible management. Commercially, mangoes are quickly perishable and generally have to be picked before they are ripe, that is, before they are acceptable to flying foxes. However, garden crops of mangoes that are left on the tree until they ripen invite a visit by flying foxes and are often laid waste. In Indonesia, garden trees are often completely encased in netting.

In some countries, flying foxes are considered food of great delicacy, but they need to be carefully prepared with spices and condiments because the skin and fur has a strong foxy odour.

▲ Common Sheath-tailed Bat roosting in a cave in the Todd Range, Gibson Desert. Photo N.L. McKenzie.

▼ Facial view of a Ghost Bat. Photo copyright A.G. Wells.

Microchiroptera

To achieve the perception required for flying at night, especially as this involves hunting insects and other small prey, the Microchiroptera have developed echo-location to a very high degree. This ability has given them an exclusive franchise on the nocturnal flying insect population, a resource universally abundant over land during warm seasons. Most of bat diversity has sprung from this enterprise. The variety of air spaces in which insects can be hunted at night entailed enormous potential for speciation (radiation) through wing design and other specializations that improved hunting efficiency.

There are high flying bats that harvest moths and beetles in the clear air-space over the vegetation canopy, species that hunt between the crowded trunks of forest trees and those that glean their prey from the bark and leaves of vegetation and the surface of the soil and water. Species of Microchiroptera have also specialized in hunting small vertebrates such as mice, lizards and even other bats. The large-footed species of the genus *Myotis* skim the surface of pools fishing with their hind feet.

Insectivorous bats are important as plant pollination agents and as voracious eaters of insects, many of which are pests of man and his crops. As an example, the Guano Bats are known to consume 6 600 tonnes of insects per year in the American state of Texas alone, about one gram per bat per night. In summer, this species is the sole vertebrate predator in Texas capable of limiting the number of night-flying insects.

Unfortunately, bat numbers are declining in several countries. Suggested causes for this decline include the destruction of breeding caves and widespread use of agricultural insecticides.