

ETHICS OF PHOTOGRAPHING BATS, GENERAL BAT INFORMATION, HISTO CAN BE DEADLY

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In many countries, bats are a protected species. Despite what many people believe, bats perform a very important role in the environment which directly benefits humans.

Because of their vulnerable existence, cave dwelling bats in particular should not be disturbed or photographed unless on specific approved research projects. A hibernating bat will slow its body functions and lower its body temperature in order to conserve precious stored body fat which sustains it during the winter when food is scarce. A hibernating bat when disturbed will instinctively raise its body temperature in preparation for flight.

The high pitch whine of an electronic flash charger, sudden flash of light or other disturbance could cause the bat to attempt flight before its metabolism can withstand it. This sort of shock could lead to the death of individuals. Consequently the photography of hibernating bats is not recommended.

Insect eating bats in particular perform an important role in the environment by consuming up to 50% of their body weight in insects each night. This helps keep pest insects in check and thus reduces the need for pesticide spraying of crops destined for human consumption. A typical example is a Bent-wing colony of 150,000 individuals studied at Naracoorte Bat Cave in South Australia which would consume up to one tonne of insects per summers night.

CLASSIFICATION OF BATS

Bats are mammals and as such have been scientifically classified under the order of *Chiroptera*, meaning 'hand winged'. This order is further divided into two Suborders of *Microchiroptera* and *Megachiroptera*.



Bent Wing Bat at Pilchers Mountain, NSW Australia. © Garry K Smith

Megachiroptera meaning 'big hand wings', comprise of about 173 species world wide. Fruit Bats and Blossom Bats, otherwise known as flying foxes, are the largest of all the bats. As their name suggests they have fox-like faces with large eyes and live on fruit or other plant material.

This group is active at night but rely on their excellent vision and smell for orientation and food location. Some overseas species have a poorly developed echolocation system which perhaps functions as a navigation aid to find their roosting sites.

Microchiroptera meaning 'small hand wings', comprise of about 800 species world wide which live predominantly on insects caught in flight.



A colony of Bent Wing bats, take to wing when disturbed. © Garry K Smith

EVOLUTION and HABITS

Bats appear to have evolved from primitive mammals similar to shrews with their origins centred around the tropics where the heat and humidity has assisted in the development of their fragile body structure. Of the 4000 or so species of mammals throughout the world, almost one quarter are bats. Bats are the only mammals which are capable of sustained flight.

Their basic forearm bones are similar to that of humans, but of very different proportions. Their wings are actually a thin membrane of hairless skin which stretches from the shoulder across to the base of the thumb and tips of the other elongated fingers of the forelimb and down to the ankle of the hind legs. The membrane usually continues from the ankles to the tail.

Power for flight is derived from muscles which pull the forearm toward the chest. The foot has five clawed toes which are usually the same length and arranged parallel to each other.

All bats can climb on vertical surfaces by supporting themselves with the claw which extends from the thumb on the leading edge of each wing and their

feet. Their awkward movement does not impair their ability to move sometimes quite fast on level surfaces.

When roosting most bats fold their wings along the sides of the body, however fruit bats wrap their wings around the body like a blanket. No muscular effort is required when hanging upside down by the claws of one or both feet, so an individual which has died in the resting position may remain suspended.

Although the roosting position is upside-down, bats will reverse themselves and hang by the thumb claws to urinate and pass faeces (guano).

The bats which inhabit caves are generally small and must overcome the problems of heat loss by radiation due to their relatively large body surface area. During flight the stretched wing

membranes vastly increase this surface area and act as immense radiators. Flight also requires much more energy than other methods of movement, so a bat must eat large quantities of food.

There is strong evidence to indicate that species sharing the same area, partition the food resource by foraging at different levels of the vegetation canopy. This is often related directly to the bats flying characteristics and manoeuvrability. There are two main feeding periods at night, each last about two-and-a-half hours. The first commences shortly after sunset and the other precedes dawn. Bats travel large distances in search of food.

Many *Microchiropterans* bats are opportunistic feeders and will prey upon whatever insects are abundant at the time within the constraints of manageable size. Catching prey on the wing scarcely interrupts rhythm of flight.

Small insects are caught directly in the mouth while larger insects are scooped up in the bats wing and transferred to the tail membrane (*Uropatagium*) and then the mouth. Large insects may be taken back to a feeding roost for disembowelment.

The unpalatable insect parts such as heads and wings are discarded. A typical diet consists of moths, beetles, flying ants, mosquitoes, flies and lace-wings.

It is believed that many species gain sufficient moisture from their insect diet, however in arid regions bats have been observed drinking water from pools, dripping straws or stalactites.

Microchiropteran bats in many cases eat up to 50% of their body weight in insects during each night of hunting. Considerable effort is required to catch enough food to provide more

energy to hunt and the never ending cycle is compounded by the loss of body warmth to cold surroundings. To counteract these problems when roosting in caves during the day, most bats hang in tightly packed clusters to conserve body heat and moisture.

In cooler climates many species hibernate during the



Common Bent-wing bats in flight, Backlit with light visible through their wings. © Garry K. Smith



Common Bent-wing bats in their roost cave. © Garry K. Smith.



Researchers disturb thousands of active bats in their roost cave, just prior to their mass exodus to forage for the night © Garry K. Smith.

winter months in chambers of caves which tend to trap the warmer air generated by the bat colony. They survive on the fat deposits built up in their bodies during the summer. To conserve energy during hibernation they allow their body temperature to drop to around that of the cave and thereby reduce the rate of energy consumption. In more temperate areas, the bats may not enter full hibernation and occasionally awaken voluntarily to feed.

Some hibernating bats have the ability of putting the

fertilisation process on hold. They mate in autumn before entering hibernation. In some species the development of the fertilised ovum is suspended, while in other the females nurture the sperm in their reproductive tract during winter, triggering fertilisation only when the days begin to lengthen and temperatures rise. The young are born around late spring and by the end of autumn are able to fend for themselves.

NAVIGATION used by the suborder (*Microchiroptera*).

Rather like many of the sea mammals, *Microchiroptera* use a combination of superb hearing and a system of echolocation which works on the same principle as radar.

Although bats have good eye sight they can still fly and feed, even if they have been blinded.



Common Bent-wing bats in their roost cave © Garry K. Smith.

Bats produce pulses of sound, which are usually beyond the range of human hearing. The sounds are emitted through the mouth or, in some bats, through the nose.

The pulses bounce back off any object which the bat encounters and the echoes are picked up by the animal's acute hearing. This enables the bat to locate and catch insects in flight as well as navigate with astonishing accuracy through tight twisted passages.

The bat's brain is about the size of a large pearl. It can process large volumes of data which the ears are receiving from the echo return signals. In addition to locating insect prey in flight, the bat can determine how far away the target is, the angular distance, the relative velocity the insect is travelling, the insect size and the speed of wing beat. It can also filter out the ripples from insect wings against the echoes associated with stationary objects, such as rock faces and vegetation.

All this is calculated by the bat in an instant, where as some of the today's most powerful signal processors and computers linked to echo location systems would be hard pressed to achieve such accuracy.

The bat uses complex neural computations to calculate the Doppler shift (change in the frequency of the echo, relative to the original signal) to determine the fleeing insects relative velocity. The amplitude of the component frequencies, correspond to the targets size. The difference in echo arrival time to each ear give the horizontal bearing, while the interference pattern of sound waves reflected within the structure of the outer ear gives the elevation.

All of the some 800 species of *Microchiropterans* world wide are presumed to echolocate using pulses of either : constant frequency (CF), frequency modulated (FM) or a combination of the two (CF-FM). CF pulses consist of single frequency, or tone. FM pulses sweep downward and sound like chirps, while CF-FM pulses consist of a long, constant tone followed by a downward chirp.

Bats shorten their duration of pulse and increase the rate of pulse emission as they are closing in on airborne prey. This is done to characterise the insect in greater detail and to assist the bat at close range as the angular position of the prey changes more rapidly. Typically these can reach as high as 100-200 pulses per second and are frequency-modulated in the ultrasonic range of 15-150kHz.

Considering the bats acutely sensitive auditory system and good eye sight must go a long way toward dispelling the myth "blind as a bat" and the idea that a bat will fly into you.

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HISTO CAN BE DEADLY

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Are you exposing yourself to the potentially deadly Histoplasmosis fungus? Photographers entering caves containing bats are particularly at risk, especially if they are unaware of the signs and symptoms of this hazard. If you have been in caves containing bat guano, it is in your interest to carefully read this article.

The disease Histoplasmosis is known around the world by many names, among them:- Histo, Cave Disease, Cave Fever, Darling's disease, Ohio Valley Disease, Tingo Maria Fever, Reticuloendotheliosis, and Reticuloendothelial Cytomycosis.



Michael Rowbottom in a cave suspected to contain Histoplasmosis fungus © Garry K. Smith.

Around the world, hundreds of thousands of people each year are affected by this fungal infection. In many areas of South America, Asia, Europe, Africa and East Central United States, the disease has been found in bat guano and droppings of domestic birds, such as fowls, starlings and other birds which often nest around houses. To humans this microscopic fungus is potentially fatal if the infection is not treated.

Evidence exists that the fungus *Histoplasma capulatum* grows in guano, (bat droppings) and may be spread by bats flying from one roost cave to another. The fungus can survive in the intestinal contents of bats as well as transmitted to other locations by wind.

In Australia the fungus has been detected in some caves inhabited by the Bent Wing Bat (*Miniopterus schreibersii* *blepotis*), however there is no conclusive evidence that it is confined to guano of this bat species.

Habitat of the Fungus.

Histoplasma capulatum is an organism which grows in soil containing a high nitrogen content, generally associated with guano of birds and bats.

The fungus reproduces by releasing spore of 2 to 5 micron in size, to the air. Ideal conditions for this to occur is in caves with high humidity (ie 67% to 87% or more), temperatures between 20 to 29 degrees C, and the presence of dry guano.

Many overseas reports have recorded high concentrations of the fungus in guano around poultry sheds. In open environments the fungus is generally restricted to between latitudes 45 degrees N and 45 degrees S. Outside of this tropical zone, concentrations of the fungus are restricted to conditions which can occur in closed environments such as caves. This is due to the stable conditions which exist inside caves, where as the surrounding countryside may be too dry or cold for sustained proliferation.

Effect on the Human Body

Histoplasmosis is a fungal infection which can affect the whole body and is caused by inhalation of an aerosol of soil, dust or guano which contains fungal spore. When the airborne spore is inhaled by humans it may infect the lungs. The degree of infection in humans varies widely, depending on the individual's immune status and degree of exposure to the fungal spores.

In most cases the spore are introduced in such a quantity as to produce a mild form of the disease, which can build an immunity to the fungus. This *Asymptomatic* infection results in the infected person experiencing no noticeable symptoms. With higher exposure levels, some spore may reach the alveoli and begin to germinate. Conversion to an invasive yeast phase takes place, and multiplication occurs by binary fission.

Acute Pulmonary Histoplasmosis causes mild symptoms which may occur two to three weeks after infection and include a general feeling of being unwell - as if suffering a mild influenza - with a raised temperature, malaise or tiredness and pleuritic chest pain. In most cases a person with a mild infection quickly recovers with no treatment.

A more severe form of infection is *Chronic Pulmonary Histoplasmosis*. This can occur with high exposure and/or low immunity to the fungus. An infected person may quickly deteriorate and show symptoms that include fever, night sweating, headaches, shortness of breath, lack of energy, muscular aching, weight loss, dry coughing and severe pain around the lungs. If untreated, the lungs continue to be slowly destroyed and death can occur months or years later from bacterial pneumonia or heart failure.

The most severe form of infection is called *Acute Disseminated Histoplasmosis*. Invasive yeasts are spread throughout the body via the blood. Overseas statistics show that in a small percentage of cases the disease may disseminate and infect the lymph glands, liver, spleen and other vital organs, resulting in fever and weight loss.

Chronic respiratory infections resemble chronic pulmonary tuberculosis. The disease progresses over a period of months to years, possibly with periods of remission. This form is more common in males over 40 and often results in death. Symptoms at the chronic stage may vary, depending on the organs involved. Unexplained fever, anaemia, heart inflammation, meningitis, pneumonia and mucosal ulceration of the mouth, bowel or stomach may be seen. The infection is not transmitted from person to person and there is no immunisation presently available.

Histoplasmosis is not only confined to humans, as animals such as dogs, cats, rats and foxes are also susceptible to infection.

Diagnosis

Several methods used to diagnose the disease:

Laboratory examination of body tissue or fluids, often sputum or scrapings of lesions.

Histopathologic examination of several tissues such as bone marrow, liver, spleen and lung, stained with special fungal stain.

Tissue culture isolation of the fungus from sputum, blood, bone marrow, biopsy tissue, lesion scrapings or other body tissue and fluids.

Serologic tests.

Histoplasmosis skin test is primarily an epidemiologic tool to define endemic areas. Its diagnostic value is limited as it does not distinguish between past and present infection, and non-specific reactions can result in false positives. (In 1972 around 100 speleologists were tested and approximately 30% returned a positive result).

Although not a conclusive diagnostic tool, a chest X-ray of severe cases will show many abnormal shadows in the lungs. Previous severe infections may be noted on a chest X-ray film as small, scattered, radio-dense nodules in the lungs, mediastinal lymph nodes, and spleen.

Treatment

Most cases recover without any specific treatment. However, even mild symptoms should be taken seriously as chronic infections may develop and result in damage to internal organs or, in extreme cases, death. Benign localised lung infections should be treated with bedrest and symptomatic care. In severe cases of histoplasmosis, the antibiotic of choice, *Amphotericin B* is intravenously administered. It should be noted that HIV positive sufferers have little chance of overcoming this fungal infection if contracted.

Entering Caves known to contain Histo.

For personal protection, cavers can, use high efficiency particle filter masks. The filters should be fine enough to remove 2-3 microns fungal spores from the inhaled air.

Cavers undertaking work in Bat Cave, Carlsbad (Southern USA) undergo the 'fit testing' of filter masks before going underground. They must enter a plastic tent full of a spray which makes them cough if their mask is not fitted properly, all while singing 'Mary Had A Little Lamb'. Beards can prevent a good fit of the mask.

A good quality fine particle dustmask

reduces, but not eliminate exposure. If you must enter a cave with high humidity and dry guano, a good fitting fine filter mask will reduce (but not entirely eliminate) the chance of infection. It is possible that the mask could be bumped, thus losing the air seal.

To reduce the chance of infection after leaving the cave, take special care to remove and dispose of contaminated clothes and wash hair before removing filter mask.



The author examines insects in bat guano of a cave suspected of containing the Histoplasmosis fungus © Garry K. Smith.

Conclusion.

If you have already visited a cave which contains dry dusty bat Guano, you have probably been exposed to the fungal spore. The more dust stirred up increases the chance of greater exposure and infection. Severity of infection may vary, depending on the degree of exposure and your state of immunity. The disease may recur in later life once infected.

Caver photographers should not become paranoid about Histoplasmosis, but should be aware of the possibility of infection and able to recognise the signs to assist in early diagnosis. Caves with wet or damp guano have greatly diminished chance of causing infection. If you must enter a cave with high humidity and dry guano, ensure that the appropriate personal protection is used.

If you suffer any Histoplasmosis symptoms after visiting a bat cave, see your doctor without delay. Mention the possibility of Histoplasmosis and that it has common symptoms with tuberculosis (TB). Prompt action could save your life. The best prevention is to avoid known sites of exposure. Histoplasmosis should not to be dismissed lightly with the old saying "*It can't happen to me*".

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