

# Bats – an important mammalian species



Heidi and Daniel Hargreaves are passionate about wildlife conservation and as a celebration of International Bat Night (24–25 August), they lead us into the private world of bats.

**B**ats make up an astonishing 20% of all mammal species, yet they are one of the planet's most misunderstood and maligned animals. Globally, they play key roles in functional ecosystems, delivering pest control, pollination and seed dispersal services. Bats are known to pollinate over 500 different types of plants and are classed as indicators of the health of our ecosystem. They range in size from the tiny 2 g bumblebee bat (Figure 1) to large flying foxes with wingspans of 5 ft and weighing 1.5 kgs (Figure 2).



**FIGURE 1:** A tiny bumblebee bat (*Craseonycteris thonglongyai*) weighing approximately 2 g.



**FIGURE 2:** A flying fox bat (*Pteropus lylei lyles*) weighs in at 1.5 kgs.

In the UK, we are fortunate to have 18 resident bat species, with a few occasional visitors. All of them, along with their roosts, are protected by both domestic and international legislation. Our bats are insectivorous, preying on a wide range of creatures, from tiny midges and mosquitos to much larger beetles and moths. They possess a unique sense, echolocation, which allows them to navigate and hunt in the dark by producing high-pitched sounds and listening to the returning echoes. Despite having perfect vision, echolocation is their preferred method due to their nocturnal lifestyle.

Bats have complex social lives and are long-lived; the record is a Brandt's bat that lived in Serbia for 41 years! And we have many species in the UK that have lived into their late teens, and some species, like the greater horseshoe bat, into their late twenties. They are slow reproducing, with females giving birth to a single pup each summer. The pups are typically born in June and July and, when first born, are naked and reliant on mum for milk (Figure 3). They develop quickly and are volant (flying) at around 5 weeks of age. UK bats mainly mate in the autumn and occasionally in Spring. Following mating, females store the sperm in their bodies and fertilize an egg in early Spring, which is triggered by warmer temperatures.



**FIGURE 3:** At birth the bat pups are naked and reliant on mum for milk. This is a greater horseshoe bat (*Rhinolophus ferrumequinum*) with its pup.

Bats evolved to live in caves and trees (Figure 4) but, today, many also live in houses and are often in residence completely unbeknown to the homeowner. In summer they like warm, safe roosts to raise their young and, in winter, they seek out cooler roosts with high humidity where they can hibernate until the insects start flying again in Spring. One of the many amazing adaptations of bats is that they can control their body temperature. In cooler weather, they can drop their body temperature to that of their surrounding environment and thus save energy. In flight, a bat's heart rate is over 600 beats per minute and as low as 30 beats per minute when hibernating. This physiological feat not only saves energy but is key to bats'

survival and their ability to survive deadly diseases such as rabies as lowering body temperature can help kill viruses and promote longer life – it could be that bats may hold the key to living longer!<sup>1</sup>.



**FIGURE 4:** A Barbastelle (*Barbastella barbastellus*) tree roost.

## Locating your nearest bat care rehabber

The best way to find a local bat rehabber is by contacting the Bat Conservation Trust (BCT) helpline (<https://www.bats.org.uk/>). BCT provides a wealth of information from training bat care courses, and advice on bat roosts. BCT also helps conserve bat species through various monitoring projects. The bat care community is hugely varied depending on where you are, with some areas having a local bat group with volunteer ambulance drivers who help to deliver a bat to the bat carers. It is worth being proactive and finding out what the status quo is now in your area (via the BCT helpline) and, ideally, updating your list yearly in time for the busy spring and summer seasons. Some bat carers will only care for adults, others will care for bat pups, and some will only care for certain bat species. For example, the bigger bat species, such as serotines, require a bigger bat flight cage. It is worth understanding the experience levels of the bat carers, and if they don't have the facilities (or time), what is the backup plan? For example, are they part of a bigger bat care network?

In Scotland, there is wildlife rehabilitation regulation, and the rest of the

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UK will potentially follow in the future. There is also the Wildlife Bat Care badge, a voluntary certificate requiring bat carers to do a bat care knowledge assessment, show their bat records, and have facilities assessed by a vet (<https://www.wildlifecarebadge.com/>).

## Considerations when admitting a bat into your practice

There are some important things for the reception team to consider when admitting bats. Adult bats need to be released from whence they came, so it is important to determine where the bat was found. The most important example of this is the bat carer may try to reunite a bat pup with its mum, so getting as accurate details as possible is important. These can often be different from the finder's details. The reception area can be bustling, so having a prepared admission form covering the following points is really helpful:

- Information on where the bat was found – including any specific details like accessibility challenges (What3words is a highly useful tool for pinpointing exact locations)
- Finder's details – address, telephone number and email
- Permission to pass on information to bat carer
- Statement that the finder knows they are passing the responsibility of 'ownership and care' to the vet practice
- Was anyone bitten? A statement giving advice such as to phone 111. BCT has an informative advice sheet entitled *I think I've been bitten by a bat* (<https://www.bats.org.uk/advice/i-think-ive-been-bitten-by-a-bat>)
- Signature signing responsibility of the bat ownership to the vet. Technically, this is not needed as wildlife cannot be owned, but it makes the finder aware it is now the vet's decision as to whether or not euthanasia is necessary, regardless of the finder's feelings and helps to avoid any future confrontation
- Additional option – ask for donations towards care.

## First triage – does it need fluids/pain relief – euthanasing?

On first inspection, the real question is whether euthanasia is necessary; if not, provide oral fluids and possibly pain relief depending on the clinical examination and history.

Reasons for opting for euthanasia include:

- Fracture – such as skull/complicated wing fracture
  - It is not wrong to consider euthanasia if a fracture is diagnosed; however, some veterinarians with experience in bats, along with seasoned bat carers, may attempt to correct simple fractures. If you believe you have a candidate for treatment, the authors would welcome your approach or, alternatively, you can contact your local wildlife vet. In the meantime, provide supportive care and pain relief. You can search the Wildlife Rescue Directory by visiting: <https://www.helpwildlife.co.uk/>
- Difficulty in breathing and clearly suffering
- Obvious uncorrectable trauma such as prolapse or missing fingers/feet, and eyes etc.

Be mindful of the bat that acts dead. Bats can hibernate and often go into torpor, so gentle warmth and oral fluids can transform a collapsed-looking bat into a much more active one.

Things to check which are useful and can potentially affect treatment choices:

- Sex – A female in spring/early summer is potentially pregnant
- Lactating – If the patient is lactating and the location of the roost is known – let the roost owner know so they can be on the lookout for a lone baby pup, making it possible that mother and pup could be reunited
- Knowing the species helps determine the bat's weight to assess its health. This is crucial for release, as a bat can appear very skinny before feeding and gain weight quickly in captivity if healthy. Key identification features include forearm length, weight, tragus shape, nose shape, ventral coloration, and calcar shape. Species identification is also important for being mindful of species commonly associated with rabies, like Daubenton and Serotine bats (Figures 5 and 6). The Field Studies Council guide offers more information (<https://www.field-studies-council.org/>).

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FIGURE 5: A Daubenton bat.



FIGURE 6: Face comparison between a Noctule (right) and a Serotine (left) bat.

## Bat anatomy

Bats' anatomy is fascinating (Figure 7). Their wing is just extended digits of the hand, with a skin membrane between each finger. In fact, bats belong to the Order Chiroptera, meaning 'hand wing'. The second and third digits are the most important for flight, so a fracture in these has a much poorer prognosis. Bats are mammals and with one pup each year, they feed from one set of nipples which are under the armpits and very lateral compared to most mammals (Figure 8). The horseshoe bats also have false nipples (around the pelvic area), which is handy for the young to hold on to when being transported by mum in flight (Figure 9). The horseshoe bats are the only bats actually to hang from the ceiling in the UK; the other bats cling on to walls and hide within crevices, heads pointing downwards, holding on with their thumbs and the claws of their feet. Bats' feet are usually in a clamped, closed position, which means they must consciously open them to release their grip, preventing them from falling while they sleep. When removing bats from their housing, be mindful of their feet. Often, a gentle tickle can encourage them to let go.



FIGURE 7: Anatomical diagram of the bat.



**FIGURE 8:** Bats have one set of nipples located very laterally under the armpits.



**FIGURE 9:** False nipples around the pelvic area in a greater horseshoe bat (*Rhinolophus ferrumequinum*).

## The basics of how to keep and care for a bat

Housing a bat in a plastic box with a tea towel for hanging provides a simple, easy, and safe way to care for it in the short term (Figure 10).



**FIGURE 10:** In the short term, a bat can be housed in a plastic box with a tea towel for hanging.

Water is the primary necessity. For adult bats, mealworms are typically provided; however, since many veterinary practices do not stock mealworms, a small quantity of cat or dog food can serve as a harmless substitute for short-term care until mealworms are available. When feeding bats, it is important to position them with their heads elevated, contrary to their typical upside-down posture. This approach makes feeding easier, encouraging initially hesitant bats to eat and retain their food more effectively.

When handling bats it is important to wear personal protective equipment (PPE), particularly gloves and a facemask. Gloves are required to protect against rabies, which can be transmitted via a bite from an infected bat. Due to the risk, the recommendation is that everyone handling bats should be vaccinated against rabies;

however, not having had a rabies vaccination doesn't prevent you from treating a bat, and with hand protection and careful handling, you can avoid being bitten. At present, rabies is rare in the UK but it is still considered a small risk. Getting involved with your local bat group or a good working relationship with your local bat rehabber can increase your confidence in handling a bat. Bat carers will be very able and willing to assist with clinical examinations.

## Common conditions and treatments

### Grounded/underweight/cat attack

Often, grounded bats may just be disturbed or were caught by a cat. Initial clinical examination checks for wounds so that initial treatment can be administered – either stabilization (fluids and pain relief) or euthanasia. *Pasteurella multocida* bacteria is commonly quoted with regards to infections caused by cat predation, but the bulk of the damage is actually the trauma caused by the mouth of the cat, which can cause death within the first few days of treatment (irrespective of whether antibiotics have been given). So, pain relief is paramount, and the patient should be treated with meloxicam and buprenorphine, depending on the extent of the injury and the severity of the shock.

### Wing membranes

Wing membrane injury can often look severe but can be very satisfying to treat (Figure 11). Wounds with better prognosis are circular, not involving fingers or splitting the wing into two separate parts by involving the edge. If the blood vessel supply is compromised, the wing membrane dries up in the following days and goes necrotic. If this happens, debride further to healthy tissue, or it may be better to euthanase. Wings with bacterial infection go sticky to the touch. Clean and prescribe antibiotics.



**FIGURE 11:** Wing membrane injury can often look severe but can be very satisfying to treat.

Suturing wing wounds should only be considered where this causes no restriction or change to the natural wing shape (check with the other wing if you are

unsure). Often, more complications occur from suturing, and compromising the wing shape impacts the bat's flying ability. Most wounds heal without any suturing intervention as long as they are healthy.

### Stuck in sticky substance – e.g. glue traps/cobwebs

Thankfully, glue traps are becoming a thing of the past, but it is not uncommon for bats to accidentally end up in unknown sticky substances, including cobwebs! Once the bat is stable, just bathe it lightly using warmed diluted hibiscrub. The key is to do this as quickly as possible and warm and dry it afterwards.

### Conditions which may happen in care – fur loss

Fur loss often occurs due to husbandry issues such as low humidity and mealworm innards getting on to the skin (which are quite acidic). The sooner the bat eats live mealworms, the better (and less messy). Increasing humidity can be achieved by leaving damp flannels within the cage.

### Metabolic bone disease

Providing the correct nutrition to bat pups is extremely difficult, especially for the bigger species. Metabolic bone disease can be a sad complication of humans rearing young (as rarely seen in wild bats). This is why it is so important for bat pups to be reared by those with experience. Substituted milk ideally needs to be low in carbohydrates and high in protein and fat; formulas frequently change, but experienced bat carers review and communicate their findings via the BCT bat carer group. As the bat grows, it is converted slowly on to mealworms by a mealworm milk soup! Milk is an important diet feature until the forearm is almost at an adult's length. It is worth remembering that mealworms are not very nutritious and 'gut loaded', such as with leafy greens, to increase their nutritional value. Keeping the mealworms well-fed and healthy is an art in itself! Your bat rehabber should know all this, but if you are experiencing problems, it's worth checking with the husbandry.

### Mealworm allergy

It is also worth mentioning the risk of mealworm allergy developing in those who are consistently exposed to mealworm frass (the waste of the mealworms).<sup>2,3,4</sup>

## Medications

There are no products licensed for use in bats. Figure 12 is information reproduced from the *BSAVA Manual of Wildlife Casualties* and is for guidance only.

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Drug	Formulation	Dose rate	Dilution	Volume of diluted product per 5 g bat	Comments
<b>Antimicrobials</b>					
Amoxicillin clavulanic acid (co-amoxiclav)	Dry powder containing 150 mg clavulanic acid plus 600 mg amoxicillin	30 mg/kg orally q12h	Reconstitute by adding 100 ml of water to dry powder Refrigerate after reconstitution and discard after 7 days	0.02 ml	Broad spectrum Duration of treatment according to response (minimum 5–7 days)
Enrofloxacin	2.5% oral solution	10 mg/kg orally q12h	Dilute 0.1 ml of solution with 0.9 ml of water	0.02 ml	Broad spectrum Duration of treatment according to response (minimum 5–7 days) Not to be used in growing animals. Make up a fresh dilution daily
<b>Anti-inflammatories/analgesics</b>					
Meloxicam	0.5 mg/ml oral suspension for cats	0.2 mg/kg orally q24h	Dilute 0.1 ml of suspension with 0.9 ml water	0.02 ml	NSAID for treatment of inflammation and mild to moderate pain Avoid use in dehydrated animals. Avoid use in pregnant animals. Make up a fresh dilution daily
Buprenorphine	0.3 mg/ml solution for injection	0.1 mg/kg s.c., orally q6–12h (Lollar, 2010)*	Dilute 0.05 ml of solution with 0.95 ml of water	0.03 ml	For treatment of moderate pain
<b>Miscellaneous</b>					
Simethicone	40 mg/ml oral suspension	400 mg/kg orally q6h	Use undiluted	0.05 ml	For use in animals with bloat
Kaolin suspension	0.99 g Kaolin Light per 5 ml oral suspension	1 ml/kg as total daily dose Given as divided dose orally q6h	Dilute 0.05 ml of suspension with 0.95 ml of water Refrigerate after reconstitution and discard after 7 days	0.02 ml	For use in animals with non-specific diarrhoea

**FIGURE 12:** Medications used in bats. This table has been reproduced from the *BSAVA Manual of Wildlife Casualties*.  
\*Lollar A (2010) *Standards and Medical Management for Captive Insectivorous Bats*. Bat World Publications, Mineral Wells, Texas

## Pain relief

Assuming a bat is fully rehydrated, you often can tell it is in pain from its eyes. Normally, the eyes of the bat are wide open and pronounced. Painful bats will either have their eyes closed or their eyes withdrawn into the sockets. I will generally always start meloxicam following oral fluid unless contraindicated, e.g. diarrhoea; after a small length of time, I will reassess, and if I do not see any improvement, I will also give buprenorphine especially in cases where the bat has been caught by a cat.

## Antibiotics

Currently, I do use antibiotics for cat bites, but this is a protocol I am reviewing. If no wounds are seen, I will try not to administer antibiotics (unless there are obvious signs of infection) and review the outcomes. This is easier for me when I see many bats but trust your judgment.

## General anaesthesia

Most commonly, bats are gassed down using chamber boxes and then converted to the end of a t-piece once the depth of

anaesthesia has been achieved. In different countries with bigger bat species, injectable pre-medications are used more commonly. I am testing this as, like with other species such as birds, giving premedication normally gives much less stressful induction, general anaesthesia, requiring less gas anaesthetic and smoother recoveries.

## X-rays

The most common reason for X-rays is to check for fractures and, if there is a fracture, to assess it for treatment. It is often difficult to get good radiographs of bats due to their size. The setting of your X-rays will be different, but I have found increasing mAs value helpful if my first X-ray setting doesn't give me enough contrast.

## How to euthanase a bat

Euthanasia can be achieved by injecting pentobarbital into intraperitoneal (if conscious) or intracardiac/hepatic under general anaesthetic. Bat carers may ask you to help them with the dislocation technique; this is a procedure using a

metal rod (such as a thin metal pen) at the point of the neck.

Ideally, dead bats should be submitted to APHA, where they can be part of the passive surveillance scheme for rabies.<sup>5,6</sup> When I was a bat carer (prior to being a vet) and I euthanased via dislocation, I would also crush the skull until I gained my confidence; however, this means the bat cannot be used for the APHA rabies surveillance scheme. I thought it was worth pointing this out as it may also be an easier way to train bat carers initially. If they feel confident, it means fewer bats coming to you requiring euthanasia.

## Why I help bats

The main reason I am a vet is to prevent suffering, whether that is to help treat or to euthanase to end suffering. Knowing I am assisting something so helpless and wrongly condemned gives me that feel-good factor. Our world ecosystem depends on bats, and even though I can't help fix the world, I can fix this bat's world, one way or the other. Bats are among the most misunderstood mammals on this planet and shouldn't be feared as much as they are. 🐉

## Case study

A pipistrelle bat was found to be grounded. On admission, the bat weighed 3.7 g and there was a swelling around the left wrist (Figure 13).



**FIGURE 13:** A pipistrelle bat found grounded had a swelling around the left wrist.

Following general anaesthesia (Figure 14), an X-ray revealed potential fractures of the 2nd and 3rd digit metacarpals; however, they were in alignment and supported by the membrane.



**FIGURE 14:** The patient was anaesthetized prior to X-ray investigation.

Pain relief of meloxicam and buprenorphine was given for the first day, and then meloxicam continued for a further 5 days. The bat was assessed weekly and once the fracture was stable after 2 weeks, flying was introduced, slowly building up over time. A month after admission the bat was fit enough to be released.

## Reflect on your reading

1. What should you include on your wildlife admit form?
2. How would you assess pain in a bat?
3. Your radiograph doesn't have enough contrast (it looks very grey). What could you do to improve this?
4. What would you do if someone were bitten by a bat?
5. Should a vet without rabies vaccination treat a bat that is suffering?

Answers available online in the BSAVA Library.

## Want to learn more about bats?

Further reading suggestions:

- Bat Conservation Trust Bat care guidelines
- *BSAVA Manual for Wildlife Casualties*
- Vale Wildlife Hospital runs several vet and vet nurse courses on different wildlife species, contact [heidi@valewildlife.org.uk](mailto:heidi@valewildlife.org.uk) to sign up to the email list.

## About the authors

Heidi and Daniel Hargreaves are passionate about wildlife conservation; Heidi is a leading wildlife vet working at Vale Wildlife Hospital and is currently studying for a conservation medicine masters at the University of Edinburgh. Daniel is the Bat Programme Manager for the Vincent Wildlife Trust. They live on the Somerset levels and have been involved in bat conservation for the past 20 years.

References and further reading are available at [www.bsavalibrary.com](http://www.bsavalibrary.com)

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