



Bat Species Identification

Technical White Paper

Bat Species in the UK

There are 18 species of bat found within the UK, 17 of which are known to breed, accounting for almost a quarter of our resident mammal species. They are considered valuable indicators of healthy ecosystems and have a huge part to play in pollination, seed dispersal and insect pest control for both agriculture and the natural environment.

Decline of Bats in the UK

Over the last century, bat populations within the UK have declined dramatically due to increases in human disturbance, intensification of agricultural practices, loss of roosts and foraging habitat, increasing pollution and a decrease in insect numbers. Since 1981, all British bat species have been legally protected by the Wildlife and Countryside Act. Since 2007, they have been protected by both domestic and international legislation, including the Conservation of Habitats and Species Regulations. This makes it a criminal offence to deliberately take, injure or kill a wild bat or to obstruct, disturb or damage a roost (even if bats are not occupying the roost at the time). In addition, the possession or sale of living or dead bat species found throughout the EU is also prohibited.

The protection of British bat species has allowed populations within the UK to begin to recover. However, they still need to be protected from the various human activities which originally led to their decline.

Effect on Planning Development

Bats may require different roosts for resting, breeding and hibernating, often moving between roosts throughout the year. Hollow trees, caves, buildings, and tunnels are frequently occupied, in both urban and rural environments. If a habitat is suitable for bats, every building and mature tree must be assumed a potential roost and treated accordingly.

Building work could lead to a removal of roosting areas or cause physical damage to any bats present. Bats are very sensitive to disturbances during the breeding season and such works may cause females to abandon their young. Additionally, open land construction may disrupt commuting routes and foraging areas if large buildings and lighting are then present.

In line with legislation, before any proposed building work can begin, thorough surveys need to be carried out to prevent damage to bat populations. First, an initial assessment will be carried out to establish the potential of the land for bat activity. Following this, surveys are carried out during the bats active season (May to September) with survey effort dependant on the results of the first assessment. The need for licence applications and mitigation works are all dependant on the results of these surveys.

Traditional Bat Surveys

There are a variety of methods utilised by ecologists to establish the presence of bats. One of the most common methods is the use of a bat detector. Bats navigate and detect prey by producing high frequency sounds, known as echolocation. Electronic bat detectors transform these sounds to those audible to the human ear, and this allows field transect surveys to be carried out. Some species, such as the Lesser Horseshoe bat have a very characteristic call which allows for easy identification. Other species, such as Bechstein's bat, are more difficult as they produce a low intensity call, which can be difficult to identify on a bat detector. Although causing no stress to the bats, there can be a bias towards low-flying species and those with higher frequency calls. This technique is thought to be better than some at detecting a range of different species, however it is widely agreed that multiple techniques should be used together for a more comprehensive study.

Roost counts, for example, allow for bats to be identified either sleeping or hibernating, or as they enter or leave the roost. These can be highly effective when a high number of existing roosts are counted and when the species is faithful to roost sites between years. However, bats may temporarily leave a roost for weeks, months or years, or abandon it completely. Leisler's bats, common pipistrelles and soprano pipistrelles are well known as highly mobile species, frequently moving between roosts, whereas greater and lesser horseshoe bats are highly dependent on their roost sites. Bat-boxes are often used as artificial roost sites, meaning these can also be surveyed visually.

Mist nets and harp traps can also be used for surveys; however, both require time to set up and need to be placed strategically along flight paths to maximise capture rate. Alongside causing stress to captured individuals, these types of traps are also biased depending in species body size and flight pattern. Finally, with any visual survey it can be extremely difficult to distinguish between some species of UK bats. Whiskered, Brandt's and Alcatheo bats are extremely similar in appearance and behaviour, all with dark grey or brown fur and hunting on insects up to 20m above the ground. Although Alcatheo bats can often be distinguished geographically from the others, Whiskered and Brandt's bat counts are often combined.



Visual identification can be difficult between similar looking species such as Whiskered bat (left) and Brandt's bat (right). However, molecular based identification can accurately differentiate between the two.



Bat Species Identification at SureScreen

With the recent improvements of DNA techniques for ecological use, researchers at SureScreen Scientifics have developed a DNA based approach to identifying bat species. From just a single dropping, we are able to identify any of the eighteen bat species within the UK, as well as some species found internationally. In some cases, the dropping may not have originated from a bat at all, which will be picked up in our test and identified to species level.

DNA analysis of bat droppings is a reliable method of identification and can be especially useful when identification from visual or audio surveys is not possible. This non-invasive survey method avoids the need for capture and handling, causing significantly less disturbance and stress to the bats.

Target Species

Alcathoe bat	<i>(Myotis alcathoe)</i>
Barbastelle	<i>(Barbastella barbastellus)</i>
Bechstein's bat	<i>(Myotis bechsteinii)</i>
Brandt's bat	<i>(Myotis brandtii)</i>
Brown long-Eared bat	<i>(Plecotus auritus)</i>
Common pipistrelle	<i>(Pipistrellus pipistrellus)</i>
Daubenton's bat	<i>(Myotis daubentonii)</i>
Greater horseshoe bat	<i>(Rhinolophus ferrumequinum)</i>
Grey long-eared bat	<i>(Plecotus austriacus)</i>
Leisler's bat	<i>(Nyctalus leisleri)</i>
Lesser horseshoe bat	<i>(Rhinolophus hipposideros)</i>
Nathusius' pipistrelle	<i>(Pipistrellus nathusii)</i>
Natterer's bat	<i>(Myotis nattereri)</i>
Noctule	<i>(Nyctalus noctula)</i>
Serotine	<i>(Eptesicus serotinus)</i>
Soprano pipistrelle	<i>(Pipistrellus pygmaeus)</i>
Whiskered bat	<i>(Myotis mystacinus)</i>
Greater mouse-eared bat	<i>(Myotis myotis)</i>

Sample Collection Method

Our sample collection method has been developed to be incredibly easy. SureScreen's sample collection kit contains everything needed for collection, including sample preservative and a postage paid box for return. Alternatively, samples can be sent straight to us, without purchasing a collection kit. A dropping sample and a reserve sample are required in case the extraction is unsuccessful the first time: the fresher a sample is, the more likely the test will be successful in extracting viable DNA.



Survey Period

The bat survey season begins in April and continues until September, during which time the bats are actively hunting and breeding. Due to the non-invasive nature of this test, it can also be carried out all year round, including during the hibernation period, as long as fresh droppings can be collected from roosts.



Visual identification can be difficult between similar looking species such as Whiskered bat (left) and Brandt's bat (right).

DNA Analysis

01. DNA Extraction

DNA is a two-stranded double helix shaped molecule made up of four different bases: adenine (A); cytosine (C), guanine (G) and thymine (T). All living organisms contains DNA in some form, and it is the pattern of the A's, C's T's and G's which are specific to every individual. However, within every species, genus, family, order etc., certain patterns are conserved which allow us to place unknown DNA within these groupings.

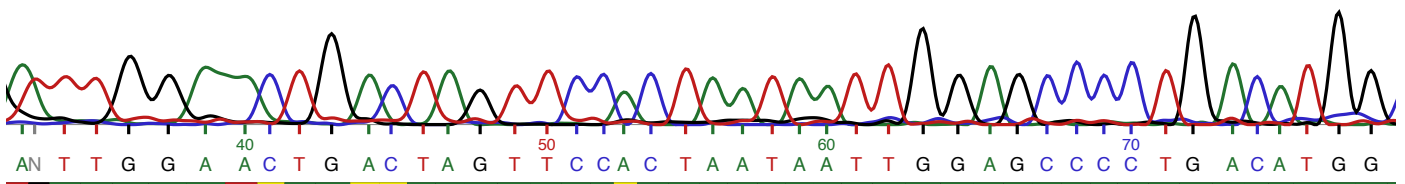
DNA extraction is the process of removing the DNA from within cells. It can be very difficult to identify a bat species by it's droppings alone (hence the need for a DNA test), so to avoid mixing two species samples that may have accidentally been collected together, only a single dropping is analysed from each sample at a time. The droppings are first shaken to break down the sample and ensure the maximum amount of DNA is extracted. This is followed by a series of solutions being added and centrifugation which gradually removes impurities and results in clean DNA at the end of the process.

02. Polymerase Chain Reaction

Faeces contains DNA from all different sources: the animal itself, it's food and any bacteria or viruses that may be living within the host. This DNA can be found at varying concentrations, but not at those high enough to be detected throughout the rest of the process. Therefore, we need to separate and amplify the DNA belonging only to the bat itself using a process called polymerase chain reaction (PCR). In order to do this, we use primers. These act in the same way as a lock and key: through a series of heating and cooling cycles, they attach specifically to and multiply only the target DNA. After the PCR process is complete, millions of strands of pure bat DNA have been created.

03. Sequencing

Once the DNA has been amplified, it is cleaned up to remove any impurities from the sample such as leftover reagents from the PCR. The concentration of the DNA is then checked to ensure that the PCR step worked. If a sample is too degraded (e.g. from exposure to sunlight, presence of inhibitors which stop the chemical reactions or just simply the age of the sample), the DNA will not have been amplified. If this is the case, we repeat the whole process with a fresh dropping to ensure the greatest chance of successfully identifying the species. Once we are certain that we have extracted and amplified DNA, the sample is sequenced. This allows us to 'read' the DNA as A's, C's, T's and G's, for example: AGGAAACCTAGCCCACGCAGGAG. By comparing this unknown sequence to sequences of known bat species, we can determine what the target species is.



Part of a DNA sequence from a Lesser Horseshoe bat

Currently, over 470 different bats from around the world can be identified down to species level using their droppings, including all bat species found within the UK.

eDNA@surescreen.com

(+44) 0 1332 292003

surescreenscientifics.com

