



Woodland Management for Bats

An advisory note
produced by the
Mercian Woodland
Biodiversity Project, a
partnership between
**Small Woods
Association** and
Severn Trent Water

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What is so special about bats?

Bats are mammals, and they are the only mammals that can truly fly. There are over 1,460 species of bat that have been identified worldwide to date (this number continues to increase), with the highest diversity of species occurring in the tropics. The diets of bats are extremely varied, ranging from fruit and nectar, small mammals, birds and even other bats, to blood, fish, and insects. Bats are night-time pollinators of plants – there are well over 500 food products that we have bats to thank for, such as mango, banana, and tequila¹ – and they play an important part in reforestation thanks to the seeds they disperse after eating fruit. Bats also provide a pest control service in agricultural landscapes; it has been estimated

that the predation of insect pests by bats in the US is worth 1 billion US dollars for corn crops alone².

We have 18 species of bat which are resident in the UK, 17 of which have breeding populations. There are also an increasing number of sightings of several vagrant species from continental Europe as our climate becomes warmer and more suitable for them. All UK bats are insectivorous, with each species preying on different invertebrates. For example, Pipistrelles eat midges and mosquitos, the Brown Long-eared favours moths, and Noctules prefer beetles. Bats are considered to be ‘bioindicators’ – their presence in the landscape is a sign of a functional and healthy ecosystem.

Brown Long-eared bat

Hugh Clark



The challenges of managing woodland for bats

An introduction

All UK bats utilise woodland to some extent, whether it is broadleaved, coniferous or mixed, ancient, semi-natural or plantation. Bats may roost within a woodland but forage far beyond its boundaries, or they may forage within the woodland but roost outside of it. but, some species are more dependent on woodlands than others and known as woodland specialists. For example, Western Barbastelle and Noctule roost almost entirely in trees in woodland habitats, and Natterer's and Brown Long-eared bat forage under woodland canopies, having evolved to be highly manoeuvrable during flight in cluttered environments. Woodland specialists each have their own specific ecological requirements, and so more complex landscapes and habitats will be able to support a higher number of bat species.

But how best to manage woodlands for bats? The use of woodland by bats is influenced by woodland size and type, its geographical location and habitat connectivity, and even the season and weather. The evidence base for successful (or unsuccessful)

woodland management for bats is currently very limited, given that bats are nocturnal and elusive, relatively difficult to study, and that their ecological requirements can vary greatly between species. Conservation Evidence³ is a useful online resource which assesses the effectiveness of conservation actions, such as practical woodland management, to make sure that conservation work is evidence-led. By summarising the findings from published studies, their synopses can help guide woodland management for bats.

The evidence, whether it is published or anecdotal, points to something which holds true for our other wild plants and animals; a mosaic of habitat types with a diverse composition of plant species, and a range of age classes along with structural complexity of the woodland will provide a multitude of different resources to support entire bat populations.

This is preferable to focusing on the provision of artificial day roosts or the conservation of one species. For



Noctule tree roost

Jim Mullholland

example, a 20-year-old plantation woodland will likely provide foraging opportunities for several individuals of the more common species of bat, but it will be unlikely to contain mature trees with multiple features that can support maternity roosts of rare woodland specialists.

Regardless of how wonderful your woodland may be for foraging, commuting and roosting bats after management interventions have been completed, species diversity and levels of activity are unlikely to be very high if individuals cannot find their way to it in the first place. Which brings us to a key component of habitat management – that of managing at a landscape scale instead of a single

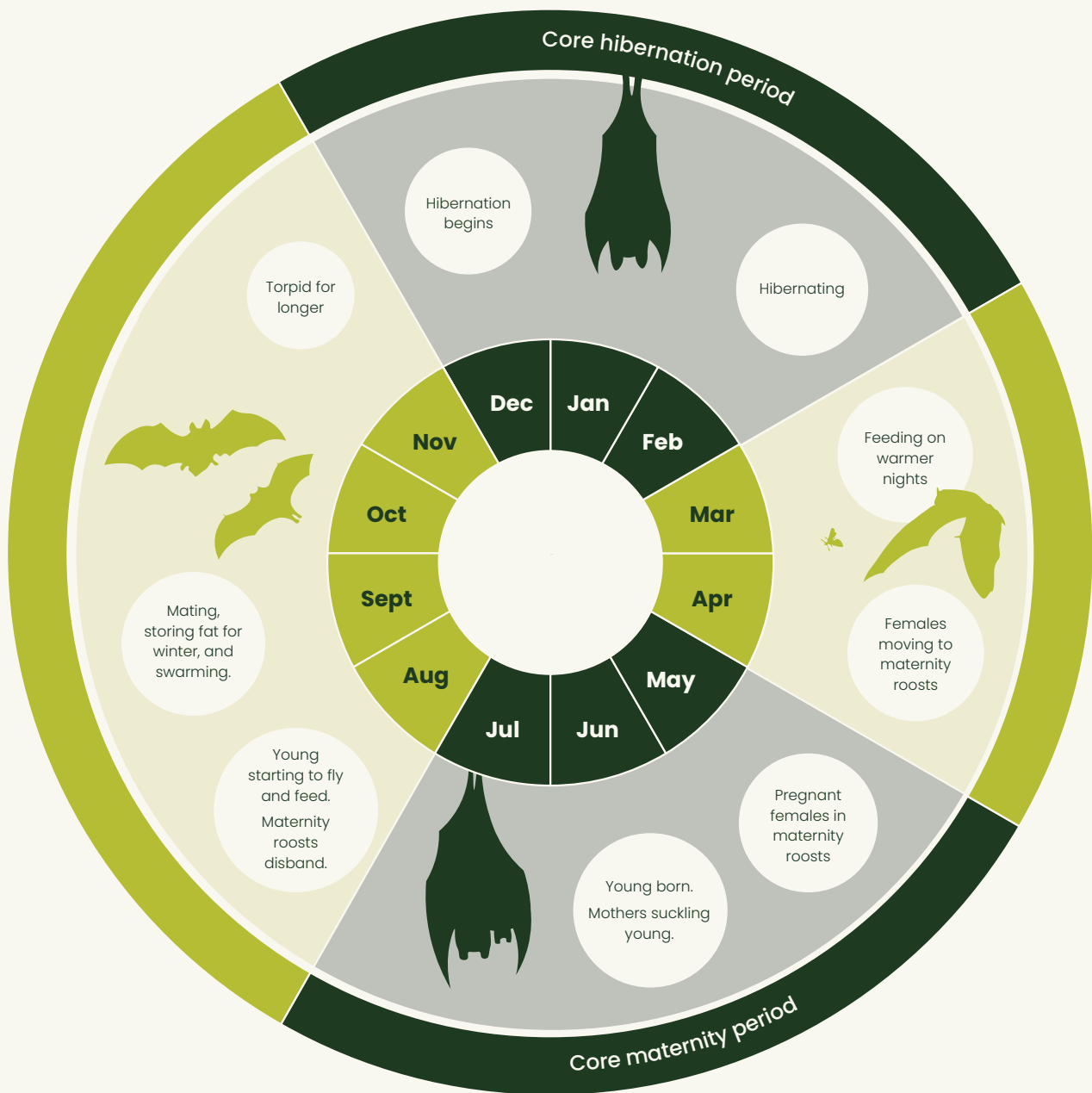
woodland. Connectivity between different areas of habitat is very important for bats, particularly linear features such as mature hedgerows, tree lines and water courses, as bats will use these to travel across the landscape between their roosts and foraging grounds. It is therefore important that your woodland has good connectivity to surrounding habitat, which may sometimes require working with neighbouring landowners to retain, enhance or create linear habitat features. Habitat connectivity is particularly important if your woodland is small, or a small part of a larger wood, as structural complexity at a site-level may not always be achievable.

Life cycle of bats

Perhaps the best time of year to begin describing the life cycle of UK bats is from December onwards, when bats go into hibernation. During the winter months there are far fewer insects around to eat and the colder weather means that bats would have to use far too much energy to keep warm and active. Instead, all of our species of bat roost in old buildings, trees, or underground in caves and mines where temperature remain fairly stable, and there they lower their body temperature and slow down their breathing and metabolic rate to conserve as much energy as possible. They occasionally wake up to move to another roost location, drink some water or forage briefly on warmer nights, but bats will generally hibernate until March when the warmer nights begin to arrive. There will be some limited activity in March but by April bats have largely finished hibernating and begin to forage on as many nights as possible – after a winter of hibernating they must be ravenous! They will also begin to move roosts frequently. By May, females of all species begin to form maternity colonies and look for suitable nursery roosts before they give birth to their pups in June. Throughout June and July, females rear their young, usually one pup per female, until they are

weaned at about six weeks old. During the summer months the males form small bachelor colonies or roost on their own, frequently moving around between roost locations. By the end of August, the majority of young are fully weaned and the maternity colonies have dispersed, with females joining the males at mating sites. Juveniles do not generally mate in their first year. Mating takes place throughout September and into October, when bats begin to start looking for hibernation roosts. Adults and juveniles alike build up their fat reserves by eating as much as possible to see them through winter. By November, they start going into extended periods of inactivity as temperatures and prey availability decrease, and some may begin hibernation. By December, bats are once more in hibernation.

Although bats roost in many different locations throughout the year, they are often faithful to their roosts, returning to the same roost feature or same area each year. This is important when considering woodland management, as the loss of a tree with a feature used as a maternity roost could have a considerable impact on the local breeding population for that year, for example.



Finding out which bats are in your woodland

A key step in managing woodlands for bats is to try and find out what is already there. The 'Woodland Assessments for Biodiversity' guidance note in this series introduces the benefits of having a biodiversity assessment and provides information on how you can carry one out yourself. When managing woodlands for bats, it is important to understand what species are already present as the presence of rarer bat species may influence the type of management interventions you carry out.

A simple desk study can be carried out in the first instance to get an idea of what species of bat may be present in your local area. The Multi-Agency Geographic Information for the Countryside (MAGIC) online mapping database magic.defra.gov.uk/MagicMap.aspx can be freely accessed to search for statutory designated sites where bats are listed as a qualifying feature, such as Special Areas of Conservation (SACs) and Sites of Special Scientific Interest (SSSIs). You can also use MAGIC to search for European Protected Species mitigation licences which have been granted by Natural England for bat roosts, which will appear at a low resolution on the map

to give you a rough idea of location and will list the species of bat that the licence covers. Local Environmental Records Centres and local bat groups are often happy to share data records for free if the purpose is for voluntary conservation, and many bat records will be available to download for free from the National Biodiversity Network website nbn.org.uk.

If you would like to find out what species of bat are using your wood, then the easiest way to do this is to buy or borrow a bat detector. Basic, entry-level bat detectors such as those by Magenta or BatBox will allow you to hear bat echolocation as they fly past you, but unless you are very good at identifying different species by the sound of their calls and with a rough idea of the frequency the bats are calling at from the frequency dial on the detector, you might not get much further than 'it's a bat'.

Hand-held or static detectors which record in full spectrum, such as the Wildlife Acoustics EM Touch (a microphone which plugs into your phone) or the Peersonic (an entry-level static detector which can be left out for a few nights), cost a little more but they are able to record bat calls onto an SD card. Professional, high-end bat

detectors such as the Elekon Batlogger M and Titley Scientific Anabat Swift have very sensitive microphones, can GPS tag recorded calls, and can be left out for longer periods of time - but they also have a considerably higher price tag! The call recordings can then be analysed using a software programme at a later date and identified to species or genus level. Local bat groups may be able to help you by loaning you a static detector for a few nights, or members may be able to come out to your woodland to carry out walked transect surveys to find out what species are active and where. For more on bat detectors go to: bats.org.uk/about-

bats/bat-detectors-1

To discover where bats might be roosting in your woodland, some local bat groups have members who are licenced to use endoscopes from ground level to inspect potential roost features in trees. Endoscope inspections can identify species and estimate the numbers present, and infra-red or thermal imaging cameras can be used to count emerging bats at sunset without causing disturbance.

Local bat groups can be searched for and contacted through the Bat Conservation Trust webpage "Contact your local bat group" bats.org.uk/support-bats/bat-groups

Barbastelle tree roost

Daniel Hargreaves



Woodland management for bats

In order to effectively manage your woodland for bats, one of the first steps is to write a management plan which clearly lays out your aims and objectives for sensitive management. As an example, one of your objectives may be to create additional roosting opportunities for bats by increasing the amount of standing deadwood. The management actions you subsequently undertake will enable your objective to become a reality.

The Woodland Wildlife Toolkit⁴ is a free online resource on managing

woodlands for wildlife. You can use the toolkit to search for wildlife in your local area, read species factsheets, assess the condition of your woodland, read through practical advice on management techniques, and access management plan templates. The myForest web tool⁵, can help you map your woodland and manage it effectively, and resources are available via the Forestry Commission⁶ to help you write your own woodland management plan.

Table 1. UK woodland bat specialists

Species	Latin name	Preferred woodland habitat
Western Barbastelle	<i>Barbastella barbastellus</i>	Old growth or mature deciduous
Alcathoe	<i>Myotis alcathoe</i>	Mature deciduous
Bechstein's	<i>Myotis bechsteinii</i>	Old growth or mature deciduous
Brandt's	<i>Myotis brandtii</i>	Broadleaf, coniferous and mixed
Whiskered	<i>Myotis mystacinus</i>	Broadleaf and coniferous
Natterer's	<i>Myotis nattereri</i>	Broadleaf, coniferous and riparian
Brown Long-eared	<i>Plecotus auritus</i>	Broadleaf and coniferous
Greater Horseshoe	<i>Rhinolophus ferrumequinum</i>	Broadleaf
Lesser Horseshoe	<i>Rhinolophus hipposideros</i>	Broadleaf

Source: Wilson, D.E. & Mittermeier, R.A. eds (2019). Handbook of the Mammals of the World. Vol. 9. Bats. Lynx Edicions, Barcelona.

Table 2. Other UK bats which will use woodlands

Species	Latin name	Preferred woodland habitat
Serotine	<i>Eptesicus serotinus</i>	---- (open landscapes)
Leisler's	<i>Nyctalus leisleri</i>	Broadleaf and coniferous
Noctule	<i>Nyctalus noctula</i>	Broadleaf
Daubenton's	<i>Myotis daubentonii</i>	Broadleaf, mixed and riparian
Nathusius' Pipistrelle	<i>Pipistrellus nathusii</i>	Riparian, broadleaf and coniferous
Common Pipistrelle	<i>Pipistrellus pipistrellus</i>	Broadleaf
Soprano Pipistrelle	<i>Pipistrellus pygmaeus</i>	Riparian
Grey Long-eared	<i>Plecotus austriacus</i>	---- (open landscapes)

Source: Wilson, D.E. & Mittermeier, R.A. eds (2019). Handbook of the Mammals of the World. Vol. 9. Bats. Lynx Edicions, Barcelona.

Managing woodland for foraging and commuting bats

The best woodlands for foraging and commuting bats contain a variety of different woodland habitat types, including mature and veteran trees, woodland glades and rides, deadwood, scrub, woodland edge habitat, dense vegetation, hedgerows, open space, wet woodland, ditches and pools of water. Such a mosaic of habitats will support a much greater diversity of plants than any one habitat type on its own, and as a result, there will be a much higher abundance and diversity of

invertebrates for bats to feed on. Woodland rides, footpaths and tracks, and edge habitats in particular are perfect corridors for bats to move along between different areas of their territory; bats may only forage in a particular area of woodland for a short period of time before moving on to a more promising area.

Several management interventions can be carried out to create a mosaic of habitat types within your woodland. The widening of main woodland rides can be achieved by scalloping one or both edges, while coppicing along rides and footpaths will create scrubby, more open habitat which will transition

nicely from dense, shaded woodland to open grassy rides. The creation of glades in larger blocks of dense woodland will provide new areas of foraging habitat, and the provision of brash and log piles around the edges of glades and along woodland rides will attract a range of invertebrates for bats to feed upon. In woodland with even-aged stands of trees, selective thinning over several years will diversify the age classes and structural diversity of the woodland, allowing an understorey and shrub layer to develop. Installing leaky dams along ditches and streams will help create and enhance wet woodland habitat, which will benefit species like Lesser Horseshoe and Soprano Pipistrelle, which like to forage over damp habitat.

For some species of woodland bat, management should be carried out much more sensitively and only after much consideration, and highlights

the need to discover what species of bat your woodland supports before implementing a management plan. For example, anecdotal evidence suggests that the rare Alcathoe is associated with woodland which contains an understorey of holly. The removal of dense areas of holly may open up the woodland and allow more daylight to reach the ground to the benefit of woodland flora, but remove too much from the understorey and the foraging habitat upon which this species may depend upon may be lost. Similarly, Bechstein's bat prefers to forage in dense stands of mature broadleaved woodland with humid conditions, and so over-zealous thinning in these areas may negatively impact their distribution within and their use of a woodland.

Coppicing, a traditional method of woodland management, can be continued as part of an active cycle or introduced as a new management

Bechstein's in flight

Daniel Hargreaves



intervention to open up areas of dense vegetation. A woodland which has been historically and actively coppiced will support bat assemblages which can exploit the environment which coppicing creates. But the coppicing of previously unmanaged mature stands of woodland should be introduced with care. Coppicing, and also heavy thinning of stands, changes the structure and climate of the woodland, altering levels of humidity and temperature, and changing the assemblage of invertebrate prey. Anecdotal evidence suggests that coppicing and thinning previously unmanaged mature woodland may increase levels of bat activity, but may also alter the composition of bats to favour species which prefer more open habitat, to the detriment of woodland specialists.

Managing woodland for roosting bats

All 18 species of bat in the UK utilise woodland for foraging, commuting and mating, but to date only 14 of the 18 species have been recorded roosting in trees⁷. Bats roost in features that are already present in a tree, whether it is living or dead; bats do not create roost features themselves and they do not make nests in the sense that birds do. Some species, such as Bechstein's

and Daubenton's, roost only in cavity features with plenty of space. Others, such as Whiskered and Common Pipistrelle, roost almost entirely in crevice features where they can tuck themselves away. A few species will happily use a mix of both of these types of roost features.

So, not only should woodlands ideally have a mosaic of habitat types and a variety of plant species to support foraging activity, but bats (generally) require older trees and standing deadwood for roosting; trees which have had time to develop a variety of different cavity and crevice features. Roost features are mainly created from either damage to the tree, such as lightning strikes and lifting bark, and from disease and decay, such as knot holes, woodpecker holes and torn-off limbs. 'Bat Roosts in Trees' by Henry Andrews⁷ is an excellent book if you wish to learn more about bats and roosts in trees.

Bats are sensitive to changes in light levels, temperature and humidity, and so management practices such as thinning and coppicing within the vicinity of trees roosts may negatively impact environmental conditions both inside and immediately outside the roost⁸. The felling of trees next to a bat roost may make individual bats more vulnerable to predation, and may cause bats to abandon the roost long-term. The aims of woodland

management in relation to bats should be to:

- protect known tree roosts;
- retain as many potential roost features as possible;
- ensure a succession of potential roost sites for the future;
- create a network of habitats used for roosting, feeding and commuting, with good connectivity to neighbouring habitat.

Woodland bat specialists benefit most from a light touch to management, and benefit in particular from the retention of trees and standing deadwood with potential roost features. If your woodland is relatively young and still establishing, or lacks trees or standing deadwood with roost features, you can help speed up the process of the formation of new roost features through ring-barking suitable trees. Ring barking speeds up the process of damage and decay, and will

ensure a succession of potential roost features in your woodland in the future. If there are no suitable trees present and you have the funding available, then the erection of bat boxes will provide artificial roosting opportunities for a range of bat species. Bear in mind, however, that bat boxes will require checking by licenced bat worker; the local bat group may be willing to help you with monitoring of bat boxes if you are unable to do so yourself.

If a tree with a known bat roost or potential roost features needs to be felled, where possible the roost feature should be retained. For example, an unsafe tree next to a public footpath may have its crown removed entirely (known as a monolithic tree) to lower the risk of deadwood falling onto the path, but retaining the trunk, to a height of 6m for example, will retain many of the roost features which may be present. Should woodland management involve the clear-fell of trees around a known tree roost or within proximity to a tree with potential



Example of Barbastelle roost feature

Jim Mullholland



Woodpecker hole with characteristic stain marks at the entrance to a bat roost | Jim Mullholland

roost features, a ring of trees should be retained to act as a buffer against changes to environmental conditions⁹.

Management advice for bat roosts in trees

Where management of individual trees or stands of trees with potential roost features needs to be carried out, for example for health and safety purposes, then bats and their roosts need to be taken into consideration. Felling trees with roost features may result in the loss of bat roosts and injure any bats that may be present; bats and their roosts are legally protected by domestic and international legislation (see Box 1).

There are two periods of the year when bats are at their most vulnerable to the impacts of woodland management. The first is during the core hibernation months of December to February inclusive, when bats have lowered their metabolism and body temperatures (please refer to Bat Life Cycle infographic p7). Not only will bats take longer to become active, but rousing individuals from hibernation will force them to use essential fat stores which may mean they won't survive the rest of winter. The second vulnerable period is in the summer months when female bats have formed maternity roosts. Disturbance to maternity roosts will likely cause the females to abandon the roost and potentially their young, which may

be detrimental to the success of the breeding season.

When carrying out necessary woodland management within vicinity of, or to trees with bat roosts or potential roost features, think:

- Are there roosting bats in my wood?
- Could management damage, disturb or harm roosting bats?
- Will management take place in habitats which bats use throughout the year?
- Are other parts of the woodland being managed with bats in mind?
- When is a bat licence needed?

Guidance for Managing Woodland with Bats in England, produced by Forest Research, the Forestry Commission and Natural England⁸, details the process of locating bat roosts and managing trees accordingly.

A European Protected Species mitigation licence will be required from Natural England where necessary tree works will disturb, damage or destroy a known bat roost. The licence application will need to be completed and submitted by a qualified ecological consultant with the relevant experience, professional licences and qualifications. A list of ecological consultancies can be found here: events.cieem.net/RegisteredPracticeDirectory/Registered-Practice-Directory.aspx



Bats and the law

All species of bats and their roosts are protected by domestic and international legislation. They are listed on Schedule 5 of the Wildlife and Countryside Act 1981 (as amended), and protected by the EU Habitats Directive, which is transposed into UK law by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019. Under these two key pieces of legislation, it is an offence to:

- Intentionally or recklessly capture, injure or kill a wild bat.
- Intentionally or recklessly disturb a bat in their roost or deliberately disturb a group of bats.
- Damage or destroy a place used by bats for breeding or roosting even if bats are not occupying the roost at any given time.
- Possess or advertise, sell or exchange a bat of any species found in the wild in Europe (dead or alive), or any part of a bat or anything derived from a bat.
- Intentionally or recklessly obstruct access to a bat roost.

Disturbance of bats under current European legislation constitutes any

activity which is likely to:

- To impair their ability to survive, to breed or reproduce, or to rear or nurture their young; OR in the case of animals of a hibernating or migratory species, to hibernate or migrate; and
- To affect significantly the local distribution or abundance of the species to which they belong.

Some species of bats are listed in Section 41 of the Natural Environment and Rural Communities Act 2006. Such species are known as Species of Principle Importance, for the conservation of biodiversity in England. Bat species listed within Section 41 include Western Barbastelle (*Barbastella barbastellus*), Bechstein's (*Myotis bechsteinii*), Noctule (*Nyctalus noctula*), Soprano Pipistrelle (*Pipistrellus pygmaeus*), Brown Long-eared bat (*Plecotus auritus*), Greater Horseshoe (*Rhinolophus ferrumequinum*), and Lesser Horseshoe (*Rhinolophus hipposideros*). These species were initially identified as priority species for conservation under the UK Biodiversity Action Plan (UK BAP), a national government action plan which aimed to identify, conserve and protect existing biological diversity, and to enhance it wherever possible.

Summary

Bats are important indicators of a healthy ecosystem. Some species of bat depend more on woodland than others, and each species has its specific ecological requirements. A first step to consider in managing your woodland for bats is to discover what species of bat your woodland already supports, as the presence of rare species may influence the management you carry out. A diversity of woodland habitat types, with various age classes and a well-developed structure, along with a diversity of plant species to support

invertebrate prey, are all essential components for foraging and commuting bats, while older and veteran trees with a range of damage and decay features will support roosting bats throughout the seasons. Above all, good habitat connectivity between roosts and foraging areas is essential at a landscape scale. The advisory notes on management of invertebrates, veteran trees and ground flora are recommended as additional reading because of the dependence of bats on these aspects of woodland management.



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Additional resources

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Bats are excellent indicators of a healthy functioning environment.



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Interested in involving your woodland in the Mercian Woodland Biodiversity Project?

If your woodland falls within the Severn Trent catchment and you would like to hear more about the project, please get in touch.

Contact the project co-ordinator

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