

6. Biodiversity

Woodlands are very important habitats for wildlife, with the potential to support a huge diversity of plants, animals and fungi. There are many ways in which to improve your woodland habitat for the benefit of biodiversity, ranging from small tweaks to large-scale operations, so there is something that everyone can do. And this is not only great for conservation, but woods with greater biodiversity are also healthier, function more efficiently and are more productive. This is because organisms (particularly fungi and invertebrates) carry out the essential ecological processes that keep the woodland ecosystem running!

One of the reasons that woodlands are so rich in wildlife is because there are so many different habitats *within* woodlands. If you walk through a wood, you might pass through a gradient of habitats, from clearings and glades to scrubby areas to dense tree cover. Then there is also a gradient of habitats as you look up through the wood, from the ground flora to understorey to young

trees to the canopy. Finally, there are also a wide variety of features found within woodlands, such as ponds, veteran trees and deadwood.

These gradients and features interact to create subtly different habitats that can be home to very different species. For example, a rotting log in a dark, moist area of woodland will support a different suite of species than a rotting log in a sunny and warm position. Similarly, the ground flora that can live under a dense canopy will be different to the flora that you find in light glades.

Different species prefer different parts of these habitats. In general, the greater the range of habitats that you can provide within your woodland, the more wildlife your wood will be able to support.

This section explores these ideas in a little more detail, and shows how sensitive and informed management of your wood can pay dividends for biodiversity.



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Structure

A mature wood with a well-developed structure should have all of the following characteristics, without any one being particularly dominant:

- □ **Field layer.** These are the grasses, ferns, flowering plants and lichens that cover the ground.
- □ Shrub layer. The low-growing plants and shrubs that reach up to about 5m in height.
- □ **Understorey**. This usually consists of low-growing and/or immature trees.
- □ **Canopy layer**. Mature trees that are a range of different heights.

□ **Deadwood**. This should be in all layers, including snags caught in the canopy, standing dead trees and on the ground.

□ Mature/veteran trees

□ **Open areas.** Glades or rides that have no mature trees, letting light reach the ground.

A lack of structure in our woods is the main reason that many woodland species are in decline. Poor woodland structure is often due to a lack of appropriate management. This leads to a closed canopy, simplified field and shrub layers, evenaged trees and few open areas. A *change* in management can similarly have detrimental effects on biodiversity – this is usually when management shifts to large-scale, uniform operations that cause a loss of structural diversity. This can



also lead to a lack of habitat continuity. This is where features such as open space are lost from a wood, perhaps due to natural regeneration of trees or tree planting, but are then not replaced in other areas. Those species that need open space habitat therefore cannot continue to live within the wood. Grazing and browsing pressures can also lead to simplification of field and shrub layers, and a lack of structure. Deer or other browsers can be a serious problem in this respect. For more information about how this, see 'Wildlife issues: deer and other browsers' in section 2. Improving your woodland.

If an area of open ground is left untouched, a succession of plants, shrubs and trees will establish and then outcompete each other, transforming the open ground to scrub and then eventually to woodland. It takes a random natural event, such as fire or very strong winds, to clear the wood and 'reset' the system. However, humans have been managing woodland for millennia, replicating these natural processes by clearing or opening up areas. Wildlife has evolved alongside both these natural and human processes, and many species rely on this disruption to the natural succession of open areas to mature woodland. This is why appropriate management of woodlands is important to retain the full range of habitats that wildlife need.

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The different structural stages and the biodiversity associated with them are explored below.

Structural stages and associated biodiversity

Different stages of woodland have very different structures and associated biodiversity. A good wood should have a mosaic of areas with all these different structural stages. Management and natural succession will inevitably lead to areas changing in their structure over time, but where possible, management should retain different stages at all times.



Dense low scrub

This is the stage when a high density of shrubs and other plants have established to form a thick, low understorey layer. There is high ground cover (e.g. brambles). This stage is favoured by invertebrates and birds such as nightingale and willow warbler.

Dense high scrub

This usually follows on from low scrub, when small trees and large shrubs create a high understorey (up to about 4m). The canopy is patchy and ground cover is reduced. A different suite of bird species favour this structural stage, such as willow tit and bullfinch. It also favours species that require dense cover, such as dormice.

Open understorey

This stage consists of taller trees with greater canopy cover. There is little understorey but likely to be some ground flora and grassy ground cover. Various fungi are associated with this structural stage, as well as birds such as redstart and tree pipit.

Open canopy

Widely spaced, usually open-grown, individual trees with substantial gaps between them. There are often high densities of deadwood. Many fungi and lichens are strongly associated with this type of structure, as they require mature trees with relatively high light levels. It is also an important habitat for invertebrates.

Closed canopy with few strata

A simple canopy layer with little understorey and ground cover. This is typical of timber plantations. This sort of habitat typically has lower biodiversity, although some fungi, plants and invertebrates are associated with it.

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Closed canopy with multiple strata

This structure is formed when the canopy layer is more complex, with mature trees of different sizes and deep crowns. There tends to be high canopy cover and good ground cover. This supports a wide range of species: birds such as Hawfinch and Lesser Spotted Woodpecker, mammals such as bats, plants and invertebrates.

Open space

Areas with no mature trees and very high light levels reaching the ground. There tends to be good ground flora and some elements of a low scrub layer. This can be temporary open space (which is a transitional stage in management, such as freshly cut coppice or clearfell) or permanent within the woodland context. This habitat is important within the woodland context, supporting high biodiversity, particularly a wide range of flowering plants and their associated invertebrates such as butterflies and moths.

Key habitats and features

Open space

Open space within a wood is a great habitat for biodiversity as it provides a warm and sunny area that is also sheltered and protected. The high light levels allow many grasses and flowering plants to flourish, and the warmth and abundance of food attract high densities of invertebrates, birds, mammals and reptiles. The edge habitat that is created between open space and mature woodland is also extremely valuable for wildlife (see 'Edges', below). You may be lucky enough to have open areas within your wood, such as rides and glades. Sensitive management can really improve these features for the benefit of wildlife. If you don't already have open space in your wood, you may want to consider creating some, although do be careful not to replace other existing valuable habitat.

----- Click here to watch RIDE MANAGEMENT video 1 ------

Planning open space

The key to creating good rides or glades for biodiversity is to allow in as much sunlight as possible, which makes them warm. It is therefore important to consider aspect. A ride running east to west will be better than a north to south ride as it will receive much more sunlight during the day and for longer in the year. The best rides for biodiversity should be at least 1.5 times wider than the height of surrounding mature trees for most of their length, which will allow sunlight to reach the ground. A glade that is 0.5-2 hectares in size will benefit the greatest variety of species but even clearing a group of just 3 or 4 trees will start to benefit wildlife.

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If you are creating rides within your woodland, consider the prevailing wind direction. It is easy to accidentally create wind tunnels, which will expose and cool down your rides, and may put your wood at greater risk of windthrow. To avoid this, don't put in rides that run in the same direction to the prevailing wind. Narrow the end of rides where they exit the woodland, and consider putting in a sharp bend just before the exit point. Having curving rides as opposed to straight ones will also help to avoid channelling wind.

It can be a good idea to create glades by cutting off the corners at ride junctions as this will require you to clear fewer trees overall to make a larger area of open space. This also



has the added benefit of connecting your glades through the ride network, which will allow species to move around. If possible, retain some isolated mature trees in your open space as this is an important habitat for many butterflies and moths. Similarly, create 'pinch points' every 50–100 m along rides where the canopies of trees on either side of the ride touch. These provide aerial pathways for animals such as dormice, allowing them to cross the rides.

The diagram below shows an example of part of a well laid out ride and glade network for wildlife.



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Managing open space

The key to managing open space habitat is to not manage everything at the same time. This will ensure that there is always suitable habitat for specialist species. For example, if you aim to cut tall vegetation on either side of a ride every 2–3 years, cut different areas on alternate years (see diagram below).



Example of cutting tall vegetation either side of a ride

Sections A: Cut in years 1, 3, 5...

Sections B: Cut in years 2, 4, 6...

If deer and rabbits are a problem then it is likely that some form of control or management will be required in order to retain a diversity of vegetation heights. However, it is worth remembering that a little grazing and its associated disturbance can be beneficial for ground flora, so very light browsing pressure can be tolerated.

Bare ground can be favourable for invertebrates, reptiles and flora, so allow scuffing and scraping by ride-cutting machinery in small areas. Rocky areas are also an important habitat. In areas of low conservation interest, creating piles of vegetation from mowing and cutting can be good for wildlife. You could also consider creating mounds from spoil excavated when maintaining or expanding ditches. However, this should be in moderation and it is better to create a few slightly larger piles than many small ones. It's also important not to move these piles around as you will disturb any wildlife that has made its home in them.

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Bracken

Bracken is often viewed as a problem in open areas and it is certainly undesirable for it to completely take over. However, violet-rich bracken habitats can be very important for fritillary butterflies so you may want to consider managing it more sensitively, particularly if your wood is in a fritillary hotspot. You do want to avoid bracken becoming too dominant, so try to create a mosaic of grassy areas and bracken areas (with bracken litter up to about 15 cm deep). This can be achieved by cutting bracken areas every 3–4 years in June, and grassy areas more regularly. Bracken bruising (where rollers are pulled behind a tractor or quad bike to damage the stems) is an effective way of reducing its density – it is best to do this in June and August. Remove bracken litter in autumn and winter by raking it up, to encourage violet growth. However you decide to manage bracken, care must be taken between March and August, as bracken is used extensively by many species, particularly reptiles and ground-nesting birds. It is important to only carry out operations when conditions are warm and reptiles are active enough to be able to move out of the way.



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Edges

Edge habitat is anywhere where woodland meets open space, and is an extremely valuable wildlife habitat. This can be the edge of the entire woodland, or the edges of rides and glades within a wood. The juxtaposition of shelter and open space makes this a particularly important habitat for many species. For example, bullfinches require woodland and scrub for nesting and open habitat for foraging.

The best edge habitats are those where the gradient from woodland to open space is as gentle as possible. You can achieve this by creating and maintaining different zones of habitat. The diagram below shows a three-zone ride system, which transitions gradually from short grass, through taller plants and scrub, to mature woodland. Management is required to prevent grassy areas developing in-



to scrub, and scrub developing into woodland, so cut or coppice the zones accordingly. See 'Managing woodland tracks' in section 2. Improving your woodland for more information.



----- Click here to watch RIDE MANAGEMENT video 2 ------

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As edge habitat is so important for biodiversity, aim to make edges as long as possible. You can do this by making curves and scallops. Scallops are curved areas on the edges of rides where mature trees are cut down, which widens the open area and allows more sunlight to reach the ride and edge. Scallops enhance structural diversity and create bigger areas of shelter. If you cannot create glades within your wood, scalloping a ride edge is a fantastic way of creating warm, open space, which will encourage ground flora and animals like butterflies and birds. Scallops of different sizes will benefit different species, but you're aiming to let sunlight reach the ground so they should be wider than the surrounding tree height (otherwise the ground will be in shade for most or all of the day). Scallops about 10– 20 m deep and 30–50 m long will be optimal for some butterflies, but smaller scallops will still be of benefit to other wildlife.

It is also best to make the edge gradient as gentle as possible on the external edges of your wood, particularly if it adjoins intensive agricultural land. Buffer strips protect the wood from exposure to spray drift and grazing. They also reduce the likelihood of windthrow, as a buffer of shrubs and plants absorb some of the wind's energy. Buffers along woodland edges should aim to follow the same pattern as described above for rides. Grassland and tall herbs will provide for-aging opportunities for birds such as turtle dove and bullfinch, while a scrub and grassland mosaic will be great for species such as nightingale and the Duke of Burgundy and black hairstreak butterflies. Generally, buffer strips need to be at least 5 m wide but the bigger they can be, the better.

Scrub

Scrub is one of the most important, yet often overlooked, habitats for biodiversity. It is used by many species (such as nightingales and dormice) for nesting, foraging and shelter. However, it is also easily lost or damaged through mechanical management, browsing (by deer or livestock)

and overshading from mature trees. There are a number of simple ways to restore and retain good scrub habitat within a wood. Opening up canopy gaps and thinning areas allows light to reach the shrub layer and reduces shading. Carefully plan operations so that damage to the shrub layer is minimised and try to only clear it when absolutely necessary. Controlling browsing pressure is essential in order to preserve good scrub habitat, as deer in particular tend to preferentially graze this layer (see 'Wildlife issues: deer and other browsers' in section 2. Improving your woodland). If this is not practical or achievable, then fencing off areas may be required.



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Wet features

Wet areas within woods are very important habitats, particularly for invertebrates, as the sheltered margins that woodlands provide around wet features are essential for many species. Where possible, try to preserve the existing hydrology of your wood, so avoid channelling or piping water and let areas flood naturally.

Humidity is an important factor in your wood. Lush foliage and damp leaf mulch benefit a wide variety of invertebrates (and consequently their predators). The best way to maintain humidity is to have a layered canopy with gaps providing dappled shade. Gaps are important as they allow light through the canopy and keep temperatures warm, whereas a completely closed canopy will keep temperatures low, which is not desirable for most wildlife. A zone of scrub at the wood edge also helps to maintain humidity as it buffers the wood from the drying effect of wind. Scrub is also particularly important for edge species that require damp conditions, such as woodcock and song thrush.



as as these are important habitats in their own right.

Ponds are a fantastic habitat for wildlife in woodlands. Ideally, they should be at least about 30 m across and shallow (favouring marginal plants). Manage the vegetation around ponds or streams to create a variety of habitats. For example, shaded and unshaded water support different specialist species, as does open water and that encroached by dense, marginal plant cover. However, don't be tempted to just create ponds in existing wet are-

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Deadwood

Deadwood is another hugely important habitat for biodiversity. Many woodland owners think that a tidy wood is a well-looked after wood, but in fact the opposite is true for wildlife. Try not to clear away fallen branches or trees. The UK Forestry Standard states that deadwood should amount to about 20 m3 per hectare, which is equivalent to approximately 3 mature oak trees, or 10 mature pine trees. This is considerably more deadwood than is found in most woods. Many species that use deadwood require certain situations or stages of decay. For example, woodpeckers use standing deadwood for nesting and dead branches caught in the canopy layer (known as snags) for foraging insects. Nightingales forage in deadwood lying on the ground, and willow tits nest in stumps. Deadwood in full sun will be home to a different suite of invertebrates and fungi than deadwood in shade, although deadwood in partial shade tends to support the richest fauna. Therefore, try to maintain deadwood in as many varied situations as possible: standing and fallen trees, large and small logs, branches on the ground and caught in the canopy, in full sun and shade, in dry and damp habitats... I

t is best to leave deadwood where it falls, but if it must be moved keep this to a minimum. Creating piles of deadwood or logs is not ideal, as they quickly become of little biodiversity value, but if there is no alternative, a few, large piles would be better than many, small piles.

If you cut material that you want to extract from your wood, take it away as quickly as possible before wildlife starts to use it. Should you need to leave it in your wood for a period, then cover it to prevent it from being colonised by wildlife.



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Veteran trees

Old trees, known as veterans, are a very important resource for lots of wildlife, yet a relatively rare and threatened habitat due to harvesting as well as health and safety concerns. Deadwood in the crown, sap runs, rot holes, broken bark and fungi are all valuable features for biodiversity, so should be retained on the tree where possible. As with deadwood, try not to 'tidy up' your veteran trees, and avoid tree surgery if you possibly can.

Saproxylic invertebrates (which depend on dead or rotting wood) are the most diverse group of organisms associated with veteran trees and are also the most threatened invertebrate community in Europe. Simply retaining and encouraging the natural ageing features of trees is one of the best ways to provide for them in your wood. Many insects that use veteran trees also require nectar sources nearby so encourage flowering trees and shrubs, such as hawthorn.

The year-round, high density of invertebrates that veteran trees support is a valuable food source for birds and bats. Veteran trees also provide great nesting sites for many of our woodland species: around a third of woodland birds require crevices or holes in trees to nest in, and all bats depend on trees to a certain extent (in particular, noctule and Bechstein's bats are strongly associated with tree roosts). Reptiles such as grass snakes also sometimes use loose bark and cavities around the base of veteran trees as resting places.

Birds, bats and the trees themselves are particularly sensitive to management at certain times of year. If you do have to carry out any management on your veterans, such as the felling of limbs, the chart below gives a general indication of when is best to do this for each of these groups: avoid management operations in months shown in red.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trees												
Bats												
Birds												

Veteran trees support a high diversity of lichens, bryophytes and fungi. In particular, exposed heartwood areas host rare lichens, and raintracks (where rainwater slowly empties from holes) support rare bryophytes. Most of these organisms are very sensitive to light and humidity so be aware of suddenly opening up areas around veterans, or allowing them to scrub up and close in.

As well as looking after and maintaining existing veteran trees in your wood, ensure that some younger trees are set apart from normal management so that they can become the veterans of the future. If you have a lack of veterans in your wood then you could consider artificially ageing younger trees by damaging them or creating cavities, but it's best to consult an expert before attempting to do this yourself.

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Ivy has a bad reputation as it's often thought to strangle and stunt tree growth. In reality, it rarely inhibits tree growth and has outstanding wildlife value. Its berries are ripe in early spring and it flowers in autumn, providing food and nectar sources at a time when few other species do. It also provides cover for nesting bats and birds, such as spotted flycatcher, hawfinch and firecrest.



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Coppice

Although most wildlife isn't confined to coppiced woodland, it provides a range of important habitats, making it one of the most wildlife-friendly management techniques.

----- Click here to watch Coppicing video 2 -----

The value of coppicing is linked to its cycle of management. The mature, closed-canopy stage shades out the lightdemanding and competitive ground flora that you find in permanent open spaces such as rides and glades. This gives shade-tolerant, less competitive woodland flora an opportunity to survive. In the first few years after cutting coppice at the start of a new cycle you are often treated to a spectacular flower display from some of our rarer woodland plants, like wood anemones, violets and bluebells. This attracts an abundance of butterflies, birds, small mammals and invertebrates. After a few years, the coppice grows up to form a dense, low habitat, which is perfect for a variety of nesting birds. Mature coppice provides ideal conditions for shade-tolerant flora, like dog's mercury, and many moths and other invertebrates.

In addition to the stage of the coppice cycle, the combination of coppice tree species also influences the wildlife that lives there. For example, tree pipits prefer chestnut coppice, whereas nightingales prefer mixed coppice. In general, the greater the diversity of coppice species, the better it is for wildlife.

Traditionally, much coppice was grown as 'coppice-with-standards', which means that a few, scattered trees were left out of the coppice regime and allowed to reach maturity. Isolated standards provide valuable habitat for many species, so aim to have standards of different ages throughout your coppice. Make sure that there are some younger trees that can be grown on to replace mature standards but also allow some to become veteran or deadwood habitat. However, coppice fails to produce good habitat for wildlife when there is too much shade, so keep canopy cover to about 10–20%, which is about 15 trees per hectare. Instead of a high density of standard trees, it would be better to have small pockets of mature

woodland.

It's also great for wildlife to leave some deadwood in your coppice rather than clearing it all after cutting. If you do want to burn brash, use as few bonfire sites as possible. Avoid weeding out less commercially viable coppice species, such as aspen and hawthorn, which are great for foraging and nesting.



up to create larger areas

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It is important to carefully consider the layout and size of your coppice coupes. Cutting adjacent coupes sequentially is best for animals like butterflies, which struggle to cross large distances and require a continuity of habitat at the same growth stage. However, the juxtaposition of coupes of different ages creates greater structural diversity and can present an ideal combination of habitats for many species. For example, some birds will nest in medium growth stages and forage in freshly cut coupes nearby. It's therefore best to include both types of layout as far as possible (see the diagram for ways this can be achieved). If your wood is too small to have many coupes, perhaps talk to your neighbours to see if you can join up and coppice together over a larger area of woodland.



Different species of wildlife prefer different sizes of coupes. For example, dormice prefer coupes that are smaller than half a hectare, whereas some birds like extensive areas of coppice. In general, coupes about half a hectare in size offer a good compromise for a wide variety of wildlife. Making your coupes irregular sizes and shapes increases the areas of edge habitat and structural diversity, which is great for biodiversity.

Many neglected coppice sites show a surprisingly good response to re-cutting, with the coppice and wildlife usually responding well. However, if your wood has not been coppiced for a very long time, then it may be better to leave it as it is, as it will probably have developed a mature woodland flora and fauna. You should only start coppicing if you can commit to it in the long-term, as the associated wildlife depends on the continuation of the coppice cycle. If you're unsure about whether it's appropriate in your wood then speak to your local Forestry Commission Woodland Officer, who will be able to offer you advice.

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Game management

Many woods are managed to provide cover for game birds. While this does not usually work well for wildlife, there are a number of ways in which sensitive game management can also deliver biodiversity benefits.

Avoid planting invasive or non-native plant species as cover, such as snowberry or Rhododendron. They will quickly spread outside their planted area and outcompete native woodland flora, shrubs and trees elsewhere in the wood. Instead, it is better to thin the canopy to allow natural regeneration and the development of a vigorous, native shrub layer. At high concentrations, game birds will compete with wildlife for food so, as a rough guide, keep densities below 700 birds per hectare. Move release pens regularly and don't position them near any areas of conservation importance – a high concentration of birds will lead to soil enrichment and changes in ground vegetation. It is also much better to use hoppers to feed your birds, rather than feeding on straw because straw will supress the ground flora and vegetation and can cause long-term degradation.

Many habitats that are good for game management can also benefit wildlife as long as they are managed sensitively. For example, rides and glades can provide feeding areas for pheasants but can also be valuable to butterflies and birds. Pheasants tend to use the woodland edge and prefer a gentle gradient of habitat from open space to mature woodland, which is also good for wildlife. Scrub habitat alongside rides, glades and the woodland exterior is good cover for pheasants, as is a well-developed shrub layer within the interior of the wood. These habitats will also be used extensively by woodland birds such as turtle dove, willow warbler and bullfinch. To achieve good habitat for both game and wildlife, thin the canopy to encourage the natural regeneration of plant species such as hawthorn, dogwood, bramble, hazel and holly.