

Woodland creation guide

# Tree species handbook

A technical guide for  
practitioners



WOODLAND  
TRUST

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# Introduction

When selecting tree and shrub species for your woodland creation project, the aim is to develop ecological communities that are appropriate for the local landscape context and which promote a strong sense of place. Species composition should be well matched to the location and conditions of the site, as described in the site assessment.

With information on **18 woodland communities** and **50 tree and shrub species**, this handbook will help you make decisions about tree and shrub species selection in the UK.

# Woodland communities

The descriptions and tables in this handbook illustrate a range of woodland communities and provide a simple framework for building species lists for different parts of your site. Woodland types are categorised according to broad definitions of location, soil type and hydrology. For each type, tree species and field-layer positive indicator plants are listed for the three structural components of **groves**, **open wooded habitats** and **glades**. The glades lists provide a handy reference when considering open grown trees in any context. A **shorthand key** for use on maps is provided for the different categories of woodland.

Eighteen woodland communities are described, divided according to broad descriptions of site characteristics and structural components (grove, open wooded habitats and glade). They are intended to support the establishment of locally appropriate and distinctive woods and trees without constraining this to specific National Vegetation Classification (NVC) communities. The inclusion of different species and their relative proportions must be site specific, with scope for natural processes (and time) to shape the composition. Therefore, the more detailed information for each of the 50 individual tree and shrub species in this handbook must be considered alongside these basic community tables. For species labelled 'local' in the communities, the maps for each individual species are an essential reference as they will help inform where a species will be most appropriate and contribute most to nature recovery.

The maps and community descriptions are original to this guide and informed by a range of sources on semi-natural habitats and vegetation in the UK, including, but not limited to, the NVC system<sup>49</sup>. Corresponding woodland NVC communities are listed for reference under the appropriate structures. The open woodland habitats and glades have affinities with non-woodland parts of the NVC (e.g. heaths and mires, grassland).

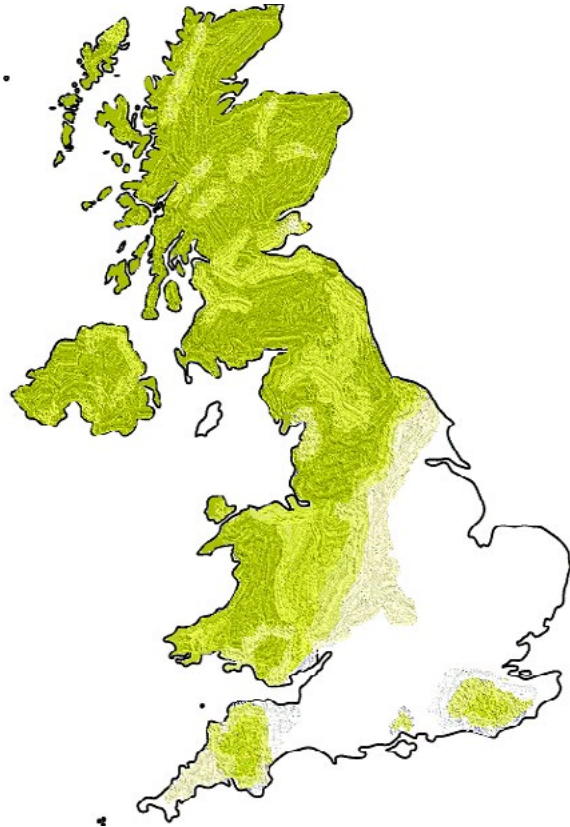


Figure 1. Woodland community structures – groves (left), glades (centre) and open wooded habitats (right).

## Acidic Upland (AU)

**Wooded habitats on acidic, relatively dry and infertile soils, mostly in upland regions or more northerly and westerly areas, typically on acidic brown earths and podzol soils.**

Many priority species are associated with these habitats. Open wooded habitats support priority birds, including redstart, tree pipit, spotted flycatcher, black grouse, woodcock and lesser redpoll. Denser young groves support willow warbler, while older groves might support pied flycatcher and wood warbler. In open wooded habitats, red wood ants and adder can occur. In the far west, rainforest groves and open wooded habitats support rich oceanic bryophytes (mosses and lichens) and filmy ferns, with invertebrates like the blue ground beetle. Acid-barked trees, such as birch, holly, rowan and Scots pine, each support distinctive lichen communities, while the occasional willow or hazel can provide important variation to support *Lobarion* lichens. Open wooded habitats and glades support lizards, colourful waxcap fungi, and insects like the bilberry bumblebee and tormentil mining bee. The combination of these wooded habitat structures will support many more widespread species, including those associated with the tree species and wider vegetation.







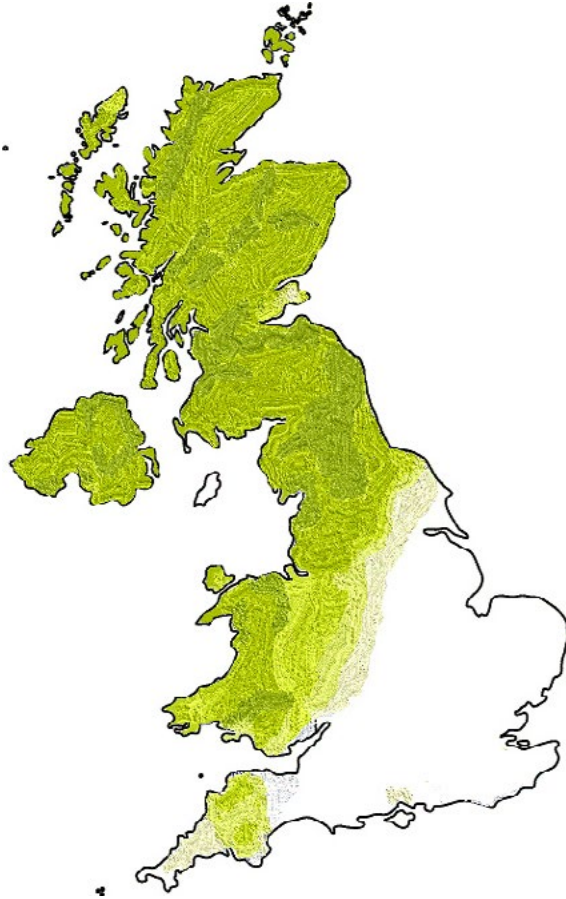
Acidic Upland – groves (AU-gr) >70% canopy cover	Acidic Upland – open wooded habitats (AU-owh) 20–70% canopy cover	Acidic Upland – glades (AU-gl) <20% canopy cover
<p>Trees: <b>sessile oak, downy birch, hazel, holly, Scots pine (local), small-leaved lime (local)</b></p> <p>Field-layer positive indicator examples: bluebell, wood sorrel, wood anemone, honeysuckle, bugle, yellow pimpernel, ivy, creeping soft grass, bilberry, scaly male fern, male fern, broad buckler fern, hard fern; and mosses, including <i>Mnium horum</i>, <i>Leucobryum glaucum</i>, <i>Plagiothecium undulatum</i>, <i>Hylocomium splendens</i>, and <i>Thuidium tamariscinum</i></p> <p>Relationship to NVC: predominately closed canopy W11, W17, transitional to W10 and W16 on edge of range.</p>	<p>Trees: <b>sessile oak, downy birch, hawthorn, rowan, holly, aspen, hazel, goat willow, grey willow, bird cherry (local), Scots pine (local), small-leaved lime (local)</b></p> <p>Field-layer positive indicator examples: pignut, common dog violet, betony, bitter vetch, honeysuckle, bluebell, raspberry, slender St. John's wort, heather, bilberry, cowberry, chickweed wintergreen, goldenrod, heath cudweed, foxglove, heath speedwell, common cow-wheat, climbing corydalis, greater stitchwort, red campion, broom, wild roses, brambles, greater wood rush, hairy wood rush, wavy hair grass, tufted hair grass, bracken; and mosses, including <i>Plagiothecium undulatum</i>, <i>Rhytidiadelphus loreus</i>, <i>Hylocomium splendens</i>, <i>Psuedoscleropodium purum</i>, and <i>Pleurozium schreberi</i>, plus any additional species from either AU-gr or AU-gl lists</p> <p>Relationship to NVC: more open canopy NVC W17, W11, in mosaic and transition to scrub (e.g. W23), acid grassland and ferns (e.g. NVC U4, U5, U16, U19, U20, U21) and acidic heath vegetation (e.g. transitional to H4, H8, H10, H12, H18).</p>	<p>Trees: <b>hawthorn, rowan, holly, sessile oak, downy birch, aspen, hazel, goat willow, grey willow, bird cherry (local), juniper (local), Scots pine (local)</b></p> <p>Field-layer positive indicator examples: heath bedstraw, tormentil, heather, bilberry, gorse, wild roses, heath speedwell, mat grass, sheep's sorrel, betony, common bird's-foot trefoil, crowberry, changing forget-me-not, bitter vetch, common dog violet, harebell, sheep's fescue, common bent grass, sweet vernal grass, wavy hair grass, early hair grass, <i>Cladonia</i> lichens; and mosses, including <i>Psuedoscleropodium purum</i>, <i>Pleurozium schreberi</i>, and <i>Rhytidiadelphus squarrosus</i></p> <p>Relationship to NVC: scattered trees and scrub among more open, semi-natural vegetation, including acid grassland and ferns (e.g. NVC U2, U4, U5, U20) or ericoid heath (e.g. NVC H4, H8, H9, H10, H12, H18). Might occur as scattered trees in more human-modified land uses, such as agriculturally modified grassland (e.g. NVC U4b).</p>



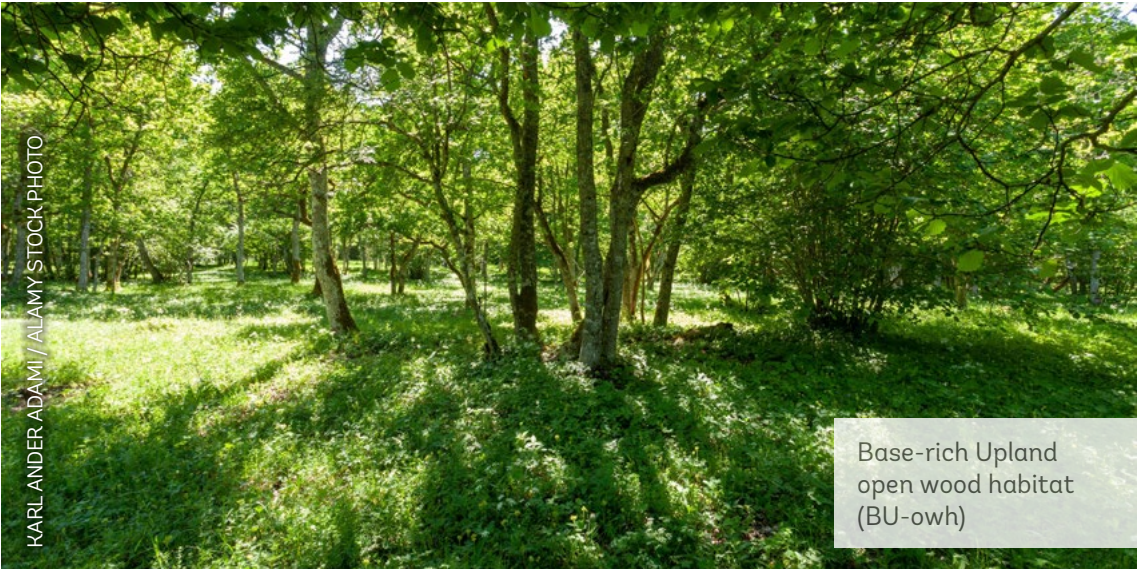
## Base-rich Upland (BU)

**Wooded habitats on base-rich, calcareous to neutral soils in upland areas or more northerly and westerly regions, typically on flushed brown earths, surface-water gleys or associated with base-rich geologies and rock outcropping.**

Many priority species are associated with these wooded habitats. In relatively clean-air sites, *Lobarion* lichens are an important feature on base-rich tree bark of ash, elm, oak, aspen, hazel (including *Lobaria*, *Sticta*, etc.) as are the smooth-bark lichens on young ash and hazel. Birds of denser groves include song thrush and marsh tit, with dormouse occurring in groves with well-developed understorey. Open wooded habitats and glades can support butterflies like pearl-bordered fritillary, and birds, including spotted flycatcher and garden warbler. Older groves support molluscs, such as the ash black slug, while open wooded habitats and glades support insects, including forester moths, oil beetles, and a wide array of bees, true flies and other invertebrates. The combination of these wooded habitat structures will support many more widespread species, including those associated with the tree species and wider vegetation.







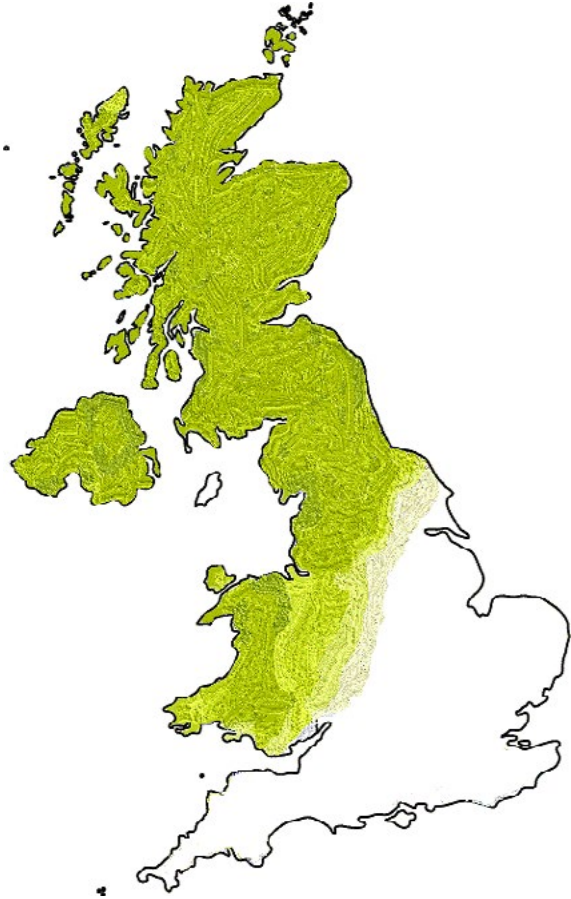


Base-rich Upland – groves (BU-gr) >70% canopy cover	Base-rich Upland – open wooded habitats (BU-owh) 20–70% canopy cover	Base-rich Upland – glades (BU-gl) <20% canopy cover
<p>Trees: <b>ash, wych elm, downy birch, silver birch (local), aspen, pedunculate oak (local), small-leaved lime (local), sessile oak, hazel, holly, yew (local)</b></p> <p>Field-layer positive indicator examples: dog's mercury, wood sorrel, enchanter's nightshade, bluebell, sanicle, herb-robert, woodruff, toothwort, common dog violet, wood sedge, ivy, wood avens, wood anemone, wood melick grass, broad buckler fern, scaly male fern, male fern, lady fern; and mosses, including <i>Atrichum undulatum</i> and <i>Eurhynchium striatum</i></p> <p>Relationship to NVC: predominately closed-canopy NVC W9, W8, sometimes in transition to W7, W10, W11, W17.</p>	<p>Trees: <b>ash, wych elm, downy birch, silver birch (local), aspen, rowan, bird cherry (local), alder (damp areas), holly, hazel, wild service (local), pedunculate oak (local), small-leaved lime (local), sycamore (local), sessile oak, Scots pine (local), crab apple (local), juniper (local), yew (local)</b></p> <p>Field-layer positive indicator examples: wild roses, red campion, common dog violet, bush vetch, barren strawberry, wild strawberry, hogweed, wood cranesbill, globeflower, bluebell, saw-wort, wild basil, nipplewort, wild angelica, cow parsley, garlic mustard, lesser burdock, raspberry, brambles, foxglove, ground ivy, hedge woundwort, tufted hair grass, false oat-grass, water avens, meadowsweet, Devil's-bit scabious, wood false-brome, plus any additional species from either BU-gr or BU-gl lists</p> <p>Relationship to NVC: more open canopy W9 and W8 in mosaic with scrub (e.g. NVC W25) and transitions to more open grassland and heath vegetation (e.g. U4, H10, CG9, CG10, U17, MG1, MG2, MG5, MG6, W19, W20).</p>	<p>Trees: <b>downy birch, silver birch (local), hawthorn, blackthorn, grey willow, goat willow, aspen, rowan, bird cherry (local), alder (damp areas), holly, sessile oak, wild service (local), ash, sycamore (local), elder, wych elm, Scots pine (local), crab apple (local), juniper (local)</b></p> <p>Field-layer positive indicator examples: bird's-foot trefoil, meadowsweet, common sorrel, Devil's-bit scabious, betony, harebell, common knapweed, oxeye daisy, meadow vetchling, tufted vetch, zig-zag clover, cowslip, yarrow, ribwort plantain, lady's bedstraw, rough hawkbit, wild thyme, sheep's fescue, wild roses, brambles, burnet saxifrage, hogweed, Yorkshire fog, sweet vernal grass, crested dog's-tail, quaking grass, bent grasses, cock's-foot, false oat-grass</p> <p>Relationship to NVC: scattered trees and scrub among grassland vegetation (e.g. U4, H10, CG2, CG3, CG9, CG10, U17, W25, MG1, MG5, W19, W20). In poorer condition, scattered trees might occur among agriculturally modified grassland (MG6 and MG7 with ryegrass, white clover, etc.) or other land uses such as arable.</p>

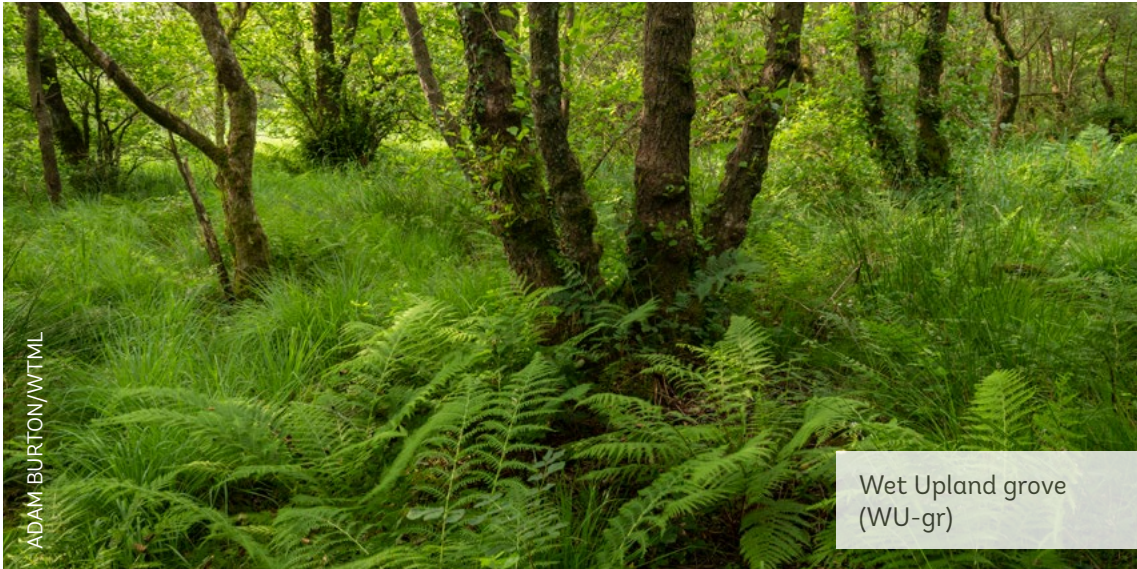
## Wet Upland (WU)

**Wooded habitats on very damp or seasonally waterlogged soils in upland or more northerly and westerly areas, typically on gleys (but not deeper peats) and alluvial soils beside watercourses or waterbodies, in floodplains or other land with high water tables.**

Many priority species are associated with these wooded habitats. Birds of denser young groves include willow tit, while reed bunting might occur in more open wooded habitats. Damp open wooded habitats and glades can support butterflies and moths, such as small pearl-bordered fritillary, chequered skipper, marsh fritillary, Scotch argus and argent & sable. The moist conditions in denser groves are important for invertebrates like crane flies, including specialists of damp, decaying wood, while damp transitions to more open glades are important for soldier flies and rare pot beetles. Rare plants include northern hawk's-beard, elongated sedge and yellow star-of-Bethlehem. The combination of these wooded habitat structures will support many more widespread species, including those associated with the tree species and wider vegetation.







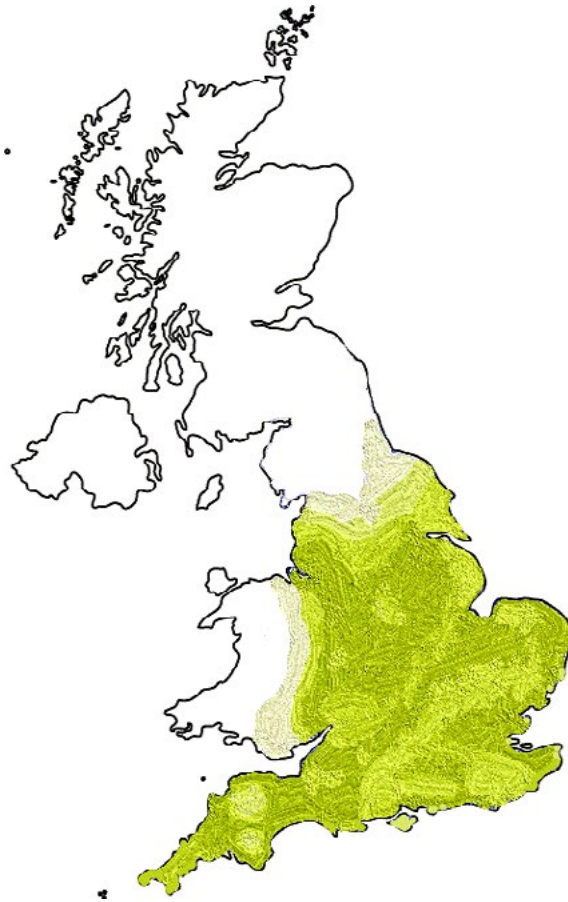


Wet Upland – groves (WU-gr) >70% canopy cover	Wet Upland – open wooded habitats (WU-owh) 20–70% canopy cover	Wet Upland – glades (WU-gl) <20% canopy cover
<p>Trees: <b>alder, downy birch, sessile oak, Scots pine (local), ash, holly, wych elm, crack willow (local) and white willow (local) on some alluvial or riparian areas</b></p> <p>Field-layer positive indicator examples: tufted hair grass, creeping soft grass, yellow pimpernel, remote sedge, wood horsetail, broad buckler fern, ivy, narrow buckler fern, smooth-stalked sedge, purple moor-grass, wood sorrel, wood avens, moschatel, bugle, enchanter's nightshade, opposite-leaved golden saxifrage, bearded couch; and mosses, including <i>Brachythecium rutabulum</i>, <i>Thuidium tamariscinum</i> and <i>Sphagnum</i> spp.</p> <p>Relationship to NVC: including a number of the wetter woodland NVC communities (e.g. W3, W4, W7), but often with transitions to drier communities (e.g. W9, W11, W17).</p>	<p>Trees: <b>alder, downy birch, grey willow, goat willow, bird cherry (local), aspen, holly, elder, guelder rose (local), bay willow (local), eared willow (local), alder buckthorn (local), sessile oak, ash, purple willow (local), dark-leaved willow – riparian (local)</b></p> <p>Field-layer positive indicator examples: wild angelica, purple moor-grass, tufted hair grass, hogweed, cow parsley, meadowsweet, water avens, common valerian, hemlock water dropwort, narrow buckler fern, bittersweet, yellow flag, red currant, purple loosestrife, greater wood rush, red campion, butterbur, wood cranesbill, melancholy thistle, garlic mustard, stinging nettle, marsh thistle, globeflower, marsh hawksbeard, marsh marigold, reed canary grass, greater bird's-foot trefoil, marsh bedstraw, tufted vetch; and mosses, including <i>Brachythecium rutabulum</i>, <i>Thuidium tamariscinum</i>, <i>Sphagnum</i> spp., plus any additional species from either WU-gr or WU-gl lists</p> <p>Relationship to NVC: more open wooded habitats in transition between wooded communities (e.g. W3, W4, W7, W9, W11, W17) and some open mire and damp grassland vegetation (e.g. MG9, MG13, M15, M23, M25, M27, M28, M36).</p>	<p>Trees: <b>grey willow, goat willow, bay willow (local), eared willow (local), holly, elder, guelder rose (local), alder buckthorn (local), bird cherry (local), aspen, purple willow (local), dark-leaved willow – riparian (local), alder, sessile oak, downy birch</b></p> <p>Field-layer positive indicator examples: meadowsweet, marsh thistle, greater bird's-foot trefoil, Yorkshire fog, marsh bedstraw, ragged robin, yellow flag, cuckooflower, common sorrel, hemp agrimony, soft rush, jointed rush, sharp-flowered rush, marsh marigold, bottle sedge, Devil's-bit scabious, great burnet, tufted vetch, purple moor-grass, tufted hair grass, and <i>Sphagnum</i> spp.</p> <p>Relationship to NVC: scattered trees and scrub among damp open mire vegetation (e.g. NVC M15, M23, M25, M27, M28, M36), damp grasslands (e.g. MG4 [rare]), or wetter swamp vegetation (e.g. NVC S4, S9). In poorer ecological condition, it might include some seasonally flooded, agriculturally modified grassland (MG6, MG7, MG10) or arable.</p>

## Acidic Lowland (AL)

**Wooded habitats on relatively acidic, dry and infertile soils in the lowlands, particularly in the drier southeast, typically on moderately acidic brown earths, podzols, base-poor groundwater gleys, sands, gravels and old alluvium.**

Many priority species are associated with these wooded habitats. In more open wooded habitats, butterflies include white admiral, heath fritillary, pearl-bordered fritillary, and green hairstreak. Sunnier, open wooded habitats and glades could support red wood-ant colonies, adder, lizards, and solitary bees and wasps on lighter soils. Birds of denser wooded groves might include nightingale and marsh tit, while more open wooded habitats and glades may support tree pipit and woodlark. Colourful waxcap and coral fungi might occur in open, grassier glades. The combination of these wooded habitat structures will support many more widespread species, including those associated with the tree species and wider vegetation.







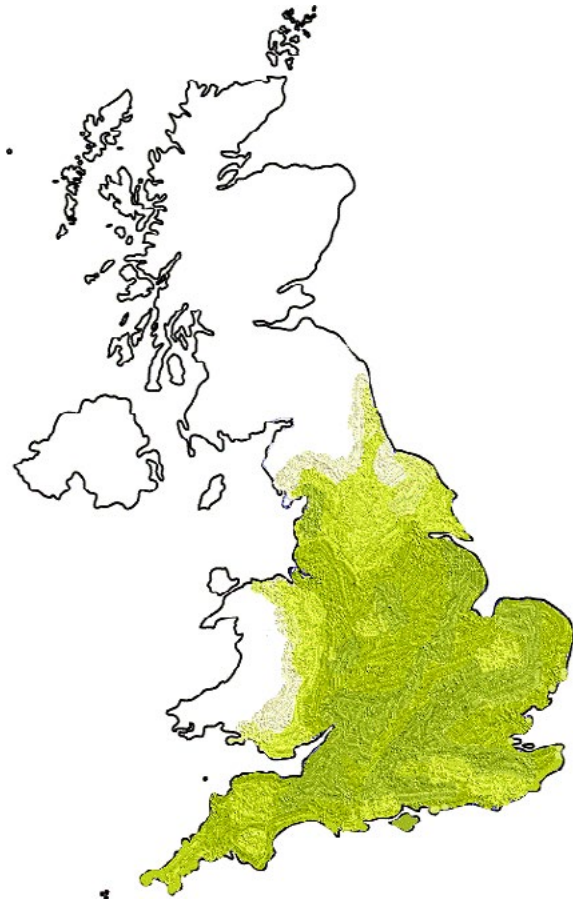


Acidic Lowland – groves (AL-gr) >70% canopy cover	Acidic Lowland – open wooded habitats (AL-owh) 20–70% canopy cover	Acidic Lowland – glades (AL-gl) <20% canopy cover
<p>Trees: <b>pedunculate oak, sessile oak (local), silver birch, downy birch (local), hazel, beech (local), hornbeam (local), holly</b></p> <p>Field-layer positive indicator examples: bluebell, creeping soft grass, wood anemone, honeysuckle, scaly male fern, male fern, ivy, broad-buckler fern, wood sorrel, butcher's-broom; and mosses, including <i>Mnium hornum</i>, <i>Plagiothecium undulatum</i> and <i>Thuidium tamariscinum</i></p> <p>Relationship to NVC: the denser wooded groves (e.g. NVC W10, W14, W15 W16, transitional to W11 and W17 on edge of range).</p>	<p>Trees: <b>pedunculate oak, sessile oak (local), silver birch, downy birch, hawthorn, rowan, holly, aspen, hazel, goat willow, grey willow, crab apple, wild cherry, beech (local), hornbeam (local)</b></p> <p>Field-layer positive indicator examples: wild roses, brambles, pignut, heather, bilberry, raspberry, wavy hair grass, heath speedwell, common dog violet, betony, heath cudweed, bitter vetch, honeysuckle, bluebell, wood spurge, common cow-wheat, slender St. John's-wort, goldenrod, greater wood rush, false oat-grass, Yorkshire fog, cock's-foot, climbing corydalis, greater stitchwort, tufted hair grass, hairy wood rush, creeping soft grass, hogweed, rosebay willowherb, gorse, broom, bracken, foxglove, red campion, wood sage, plus any additional species from either AL-gr or AL-gl lists</p> <p>Relationship to NVC: more open wooded patches (e.g. NVC W10, W16) in mosaic and transition to scrub (e.g. W23, although some scrub ecotones not well described by NVC), acid grassland and ferns (e.g. NVC U4, U2, U20) and acidic heath vegetation (e.g. transitional to H4, H8, H9, H12, H18).</p>	<p>Trees: <b>pedunculate oak, sessile oak (local), silver birch, downy birch, hawthorn, rowan, holly, aspen, hazel, goat willow, grey willow, crab apple, wild cherry, beech (local), hornbeam (local), blackthorn, elder, guelder rose</b></p> <p>Field-layer positive indicator examples: heath bedstraw, tormentil, heather, bilberry, Yorkshire fog, sheep's fescue, red fescue, common bent grass, sweet vernal grass, common sorrel, heath speedwell, gorse, wild roses, wavy hair grass, sweet vernal grass, early hair grass, sheep's sorrel, changing forget-me-not, trailing tormentil, betony, bitter vetch, common dog violet, harebell, <i>Cladonia</i> lichens, mouse-ear hawkweed, and mosses including <i>Rhytidiadelphus squarrosus</i></p> <p>Relationship to NVC: scattered trees and scrub among more open semi-natural acid grassland and fern vegetation (U1, U2, U3, U4, U20) and acidic heath vegetation (e.g. H4, H8, H9, H12, H18).</p>

## Base-rich Lowland (BL)

**Wooded habitats on dry, base-rich, calcareous to neutral soils in the lowlands or more southerly regions. Typically on soils overlaying limestones, calcareous shales and clays and heavy lime-rich deposits like boulder clay. Soil types include rendzinas, calcareous brown earths, basic brown earths and some base-rich groundwater gleys. These may range from infertile to more fertile soils.**

Many priority species are associated with these wooded habitats. Denser groves might support species such as nightingale, marsh tit and song thrush, while scrubby or open-structured areas support bullfinch, tree sparrow, turtle dove, barn owl and yellowhammer. Open wooded habitats and glades might support butterfly priorities, including Duke of Burgundy, grizzled skipper, brown hairstreak, black hairstreak, or bees, such as the shrill carder bee. Rare plants like wood calamint, spreading bellflower, and crested cow-wheat are also generally associated with more open wooded habitats and transitions to glades, while some denser groves might support rare helleborine orchids. More transitional mosaics of open wooded habitats and glades might support insects, including various blue butterflies, woodland grasshopper and glow-worms. The combination of these wooded habitat structures will support many more widespread species, including those associated with the tree species and wider vegetation.







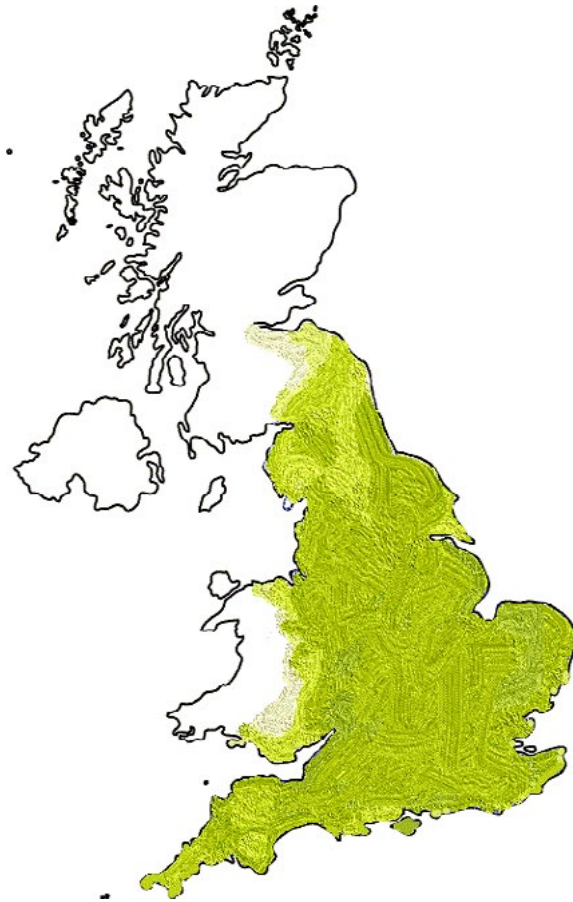


<b>Base-rich Lowland – groves</b> <b>(BL-gr) &gt;70% canopy cover</b>	<b>Base-rich lowland – open wooded habitats</b> <b>(BL-owh) 20–70% canopy cover</b>	<b>Base-rich Lowland – glades</b> <b>(BL-gl) &lt;20% canopy cover</b>
<p>Trees: <b>ash, wych elm, field maple, silver birch, pedunculate oak, downy birch (damper), hazel, beech (local), hornbeam (local), small-leaved lime (local), large-leaved lime (local), sessile oak (local), Midland hawthorn (local), yew</b></p> <p>Field-layer positive indicator examples: dog's mercury, lords-and-ladies, ramson, bluebell, wood anemone, primrose, early dog violet, yellow archangel, wood avens, herb paris, toothwort, enchanter's nightshade, ivy, woodruff, three-nerved sandwort, wood sedge, sanicle, black bryony, herb-robert, spurge laurel, hairy brome, wood melick, male fern, broad buckler fern</p> <p>Relationship to NVC: the denser wooded groves (e.g. NVC W8, W12, W13).</p>	<p>Trees: <b>downy birch, silver birch, holly, crab apple, rowan, aspen, grey willow, pedunculate oak, ash, wych elm, field maple, wild cherry (local), common whitebeam (local), hornbeam (local), beech (local), sycamore (local), small-leaved lime (local), wild service (local), sessile oak (local), hazel, yew, Midland hawthorn (local), spindle, privet, hawthorn, guelder rose, dogwood, purging buckthorn (local), wild service (local)</b></p> <p>Field-layer positive indicator examples: red campion, greater stitchwort, wild roses, brambles, giant fescue, garlic mustard, white bryony, wild clematis, hogweed, deadly nightshade, wild liquorice, cow parsley, foxglove, common calamint, wild basil, hedge woundwort, lesser burdock, wild strawberry, saw-wort, wild marjoram, perforate St John's-wort, nipplewort, agrimony, wood sage, herb-robert, ground ivy, early dog violet, sweet violet, nettle-leaved bellflower, wood spurge, pignut, bush vetch, false brome, hairy brome, cock's-foot, tufted hair grass, false oat-grass, plus any additional species from either BL-gr or BL-gl lists</p> <p>Relationship to NVC: more open wooded habitats in mosaic and transition between denser wooded groves and scrub (W8, W12, W13) to more open neutral grassland (MG1, MG2, MG5) and calcareous grassland (CG2, CG3, CG4, CG5).</p>	<p>Trees: <b>blackthorn, elder, silver birch, downy birch, guelder rose (local), goat willow, privet (local), dogwood (local), spindle (local), wayfaring tree (local), purging buckthorn (local), holly, crab apple, rowan, aspen, grey willow, pedunculate oak, ash, wych elm, field maple, wild cherry (local), wild service (local), common whitebeam (local), beech (local), sycamore (local), common barberry (local), hornbeam (local), small-leaved lime (local), hazel, hawthorn, yew</b></p> <p>Field-layer positive indicator examples: bird's-foot trefoil, common knapweed, oxeye daisy, cowslip, sweet vernal grass, crested dog's-tail, common sorrel, meadow vetchling, tufted vetch, yarrow, wild thyme, sheep's fescue, red fescue, ribwort plantain, lady's bedstraw, rough hawkbit, salad burnet, field madder, fumitories, quaking grass, cock's-foot, ploughman's spikenard, wild parsnip, wild roses, hogweed, field scabious, Devil's-bit scabious, false oat grass, tor-grass, upright brome</p> <p>Relationship to NVC: scattered trees and shrubs among dry, neutral and calcareous grassland vegetation (MG1, MG5, CG1, CG2, CG3). Poorer condition glades may include scattered trees in more agriculturally modified vegetation (e.g. NVC MG7 or arable).</p>

## Wet Lowland (WL)

**Wooded habitats on wet or seasonally waterlogged soils in the lowlands, particularly in the south and east – typically on alluvial soils, floodplains, beside waterbodies, and on gleys or other soils with high water table (but not deeper peats).**

Many priority species are associated with these wooded habitats. Birds of denser young groves include willow tit, while reed bunting and Cetti's warbler might occur in more open, scrubby habitat, and barn owl, snipe and woodcock might be found in mosaics with open glades. Damp, open wooded habitat structures can support butterflies such as the small pearl-bordered fritillary. The moist conditions in denser groves are important for invertebrates like craneflies, including specialists of damp, decaying wood. In areas with ponds, damp wooded habitats support great crested newts and other amphibians, while damp transitions to more open glades are important for soldier flies and rare pot beetles. The combination of these wooded habitat structures will support many more widespread species, including those associated with the tree species and wider vegetation.









Wet Lowland – groves (WL-gr) >70% canopy cover	Wet Lowland – open wooded habitats (WL-owh) 20–70% canopy cover	Wet Lowland – glades (WL-gl) <20% canopy cover
<p>Trees: <b>alder, downy birch, ash, black poplar (local), holly, crack willow, white willow; where frequency of inundation is lower: pedunculate oak, wych elm, small-leaved lime (local), hornbeam (local)</b></p> <p>Field-layer positive indicator examples: yellow pimpernel, remote sedge, opposite-leaved golden saxifrage, wood sorrel, honeysuckle, dog's mercury, wild garlic, wood anemone, moschatel, bugle, enchanter's nightshade, wood avens, ivy, tufted hair grass, broad buckler fern</p> <p>Relationship to NVC: including some of the wet woodlands (e.g. W2, W5, W6, W7), but sometimes transitional to drier woodland NVC types (e.g. W8, W10) in areas with less frequent inundation.</p>	<p>Trees: <b>alder, downy birch, grey willow, guelder rose (local), alder buckthorn (local), pedunculate oak, ash, black poplar (local), small-leaved lime (local), goat willow, aspen, holly, elder, hornbeam (local), purple willow (local), crack willow, white willow, osier willow, almond willow, bay willow (local)</b></p> <p>Field-layer positive indicator examples: wild angelica, hogweed, cow parsley, meadowsweet, water avens, hemlock water dropwort, butterbur, common valerian, purple loosestrife, creeping Jenny, hemp nettle, marsh thistle, yellow flag, stinging nettle, greater bird's-foot trefoil, bittersweet, hedge bindweed, red currant, marsh bedstraw, garlic mustard, yellow loosestrife, tufted vetch, red campion, marsh marigold, common nettle, tufted hair grass, reed canary grass, plus any additional species from either DL-gr or DL-gl lists</p> <p>Relationship to NVC: more transitional between the woodland NVC communities listed for groves and patchy mosaics grading into damp grasslands (e.g. MG8, MG9, MG10, MG13), and other tall-herb open vegetation (e.g. OV26, OV24), mire (e.g. M23) or swampy pockets (e.g. NVC S17).</p>	<p>Trees: <b>goat willow, grey willow, guelder rose (local), aspen, holly, elder, alder buckthorn (local), purple willow (local), osier willow, almond willow, bay willow (local), crack willow, white willow, alder, downy birch, pedunculate oak, ash, black poplar (local), small-leaved lime (local)</b></p> <p>Field-layer positive indicator examples: wild angelica, meadowsweet, marsh thistle, greater bird's-foot trefoil, marsh bedstraw, tufted hair grass, hemp agrimony, common fleabane, ragged robin, cuckooflower, common sorrel, yellow flag, Devil's-bit scabious, great burnet, meadow foxtail, marsh marigold, tufted vetch, Yorkshire fog, soft rush, jointed rush, sharp-flowered rush</p> <p>Relationship to NVC: scattered trees and shrubs among damp or seasonally wet grasslands (e.g. NVC MG4, MG8, MG9, MG10, MG11, MG13), other open vegetation (e.g. NVC OV26, OV24, OV30, OV31, OV32), or more open swamp communities (e.g. NVC S26, S28) and mires (M23, M24, M28), and agriculturally modified vegetation (e.g. NVC MG7 or S5, or arable).</p>



# Tree and shrub species characteristics

## Species included in the handbook

This handbook provides information on the 50 tree and shrub species that can contribute most to nature recovery and the ecological resilience of UK woodland. It includes 46 native trees and shrubs and four species that are widespread and naturalised archaeophytes (present in the British Isles since before AD 1500). The naturalised species included can provide important ecological functions, particularly where native species are impacted by pests or diseases. However, many of these functions can also be provided by other native species and it is important to consider the woodland habitat and community as a whole in your design.

An overview of the key characteristics and associated wildlife for each tree and shrub species is provided, along with a simple scoring system to indicate the relative tolerance of each species to shade, drought, waterlogging, herbivory and soil fertility.

The suitability of each species for the different structural components of a woodland community is also described. This is a key consideration in your design as the characteristics and functions of many species will vary between growth stages (sapling to veteran) and between groves and more open settings in open wooded habitats and glades. The capacity of each species to disperse and colonise sites is also described to inform decisions about planting, seeding and/or natural colonisation in the initiate phase of your project. How each species responds to management and disturbance is also described to help support decision making through the establish phase, promoting natural regeneration and the development of dynamism and structural complexity.

**Not included** are the very **minor native species** (such as microspecies of whitebeam and elm), but these should not be forgotten in some creation schemes where they may be locally relevant (see list on page 128), and other **non-native trees** which may be important for some production objectives (see examples on page 129).

## What the maps show

The maps in this handbook are a general guide to where a species might be most appropriate and where they are likely to contribute most to ecological resilience and nature recovery. The maps are intentionally small and hazy so that very local scale differences are not clear. If you find yourself zooming in to try and make a distinction between an area, you have taken things too far!

For those areas shaded darkest blue, you can have most confidence that the species is suitable and will contribute most. For lighter shaded areas, you may need to ask yourself more questions about why you would include a particular species. You should avoid species being planted or seeded in parts of the maps coloured white, but natural colonisation from planted or naturalised individuals within or near to a project site could be acceptable as part of woodland establishment. These might be removed or managed later if they are problematic, or competing with target species.

## Evidence

The maps and descriptions provided are original to this guide, informed by a range of data and sources, including, but not limited to, the distributional data from the Botanical Society of Britain and Ireland (BSBI), autecological studies (Biological Flora of the British Isles accounts – see references), the Ecological Flora of the British Isles<sup>13</sup>, local county floras where available, and to a lesser extent, the National Vegetation Classification system<sup>49</sup>.

The key characteristics scoring for shade, drought and waterlogging are drawn from Niinemets and Valladares (2006)<sup>40</sup>. The key characteristics for fertility are adapted from Ellenberg values for nitrogen (N), as a general indication of soil fertility tolerances<sup>17</sup>. The information on mycorrhizal associations is from Brundrett and Tedersoo (2020)<sup>4</sup> and Soudzilovskaia et al. (2020)<sup>53</sup>.

The herbivory scoring is original to this guide and is based on internal data and a range of sources of information on the palatability and herbivore tolerances of different trees and shrubs, although this is more evidence-limited for some species, and herbivory scores require considering with that in mind. The herbivory scores are, however, very simplified and crudely combine the palatability of a species with its resilience and ability to respond to browsing damage. For example, some species may be palatable, but can be more resilient in response to browsing damage by regrowing, and vice versa. Palatability can also vary with the season and possibly between sites, landscapes and different herbivores. All other sources of evidence for information on species ecology are referenced (see references).

## A key to the species characteristics

Tolerances/relative competitiveness:

**0–1.9 = low tolerance/poorly competitive**

**2.0–3.4 = intermediate tolerance/competitiveness**

**3.5–5 = high tolerance/strongly competitive**

Months = key flowering periods (**month**) to consider blossom sequences for insects/pollinators

**Major** component: a species that might be relatively abundant (potentially making up >20% of all the trees and shrubs in an area) and frequent across an area (individuals constantly found within approximately 20 metres of most stopping points on a walk)

**Minor** component: a species that is typically less abundant (usually making up <20% of the trees and shrubs in an area), and generally less frequent (found infrequently within approximately 20 metres of most stopping points on a walk), although they may be locally frequent in distinct areas (many individuals might be found in one particular area)





## Alder (*Alnus glutinosa*)

### Ecological characteristics

**Status:** native deciduous tree  
**Height:** large (up to 35 metres)  
**Girth:** potentially to 5–6 metres  
**Longevity:** potential for long life (250+ years)

**Shade:** 2.7

**Drought:** 2.2

**Waterlogging:** 3.9

**Herbivory:** 3.8

**Fertility:** 3.5

**Supports:** over 280 insect species<sup>39</sup>, including moths such as alder kitten and May highflyer. Early blossom (**Feb–Apr**), good for pollinators. High volumes of small seed for birds (e.g. siskin, redpoll). Also supports acid-bark lichens, with communities changing from smooth bark when young to fissured when older. Range of associated mycorrhizal and decay fungi. By water, its roots reduce erosion and provide shelter for fish and otters. Fallen leaves deliver nutrients for aquatic life such as caddisflies and stoneflies.

### Design

**Site characteristics:** A key tree and **major** component of many woods on wet, damp or riparian soils (**WU/WL**) of a wide pH range across the UK. Could also be a **minor** component on damper soils or riparian (beside watercourses) areas in otherwise drier habitats (e.g. **AU/AL/BU/BL**).

**Structures:** Maximise contribution to nature recovery by representing across all densities (**gr/owh/gl**). Ensure that some alder occur as open grown, spreading, crowned individuals, with limited crown competition from early age (**gl**).



## Initiate

**Dispersal/natural colonisation:** Light-demanding pioneer. Establishes from seed if deposited on moist, exposed or muddy soils with sun. Most dispersal may be limited to around 20 metres by wind<sup>14</sup>, but considerably further if by water transport. Seed also moved further on animals (e.g. deer, cattle, etc.). Seeds from an early age and monoecious (male and female flowers on same tree), so a few individuals soon support more colonisation. Alder forms both ectomycorrhizas and arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding can be successful<sup>64</sup>, requiring moist soils in spring. Where planting is required, use local provenance material, UK sourced and grown.

## Establish

Individuals can establish as part of young groves (**gr**), but regeneration of new individuals will require dynamism in open wooded habitats on damp soils (**owh**) and within open damp vegetation areas (**gl**). As it's relatively more tolerant of herbivore pressures, consider the role of animals in driving space and dynamism in wooded habitats. Establishing some individuals as more open grown trees will require maintaining crown space.



DAVID FOKER/WTML

Large volumes of small seed support birds like siskin, which are in turn prey for raptors, such as sparrowhawk and merlin.



IAN ANDREWS/WTM

## Alder buckthorn (*Frangula alnus*)

### Ecological characteristics

**Status:** deciduous, locally native shrub or small tree

**Height:** small (4–6 metres)

**Girth:** potentially to 1+ metres

**Longevity:** potentially to 150+ years

**Shade:** 2.7

**Drought:** 1.4

**Waterlogging:** 3.2

**Herbivory:** 4.0

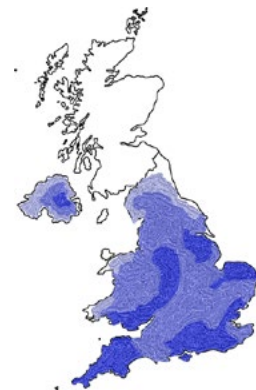
**Fertility:** 3.0

**Supports:** over 30 species of insect<sup>39</sup>, being key larval foodplant for brimstone butterfly and other insects like moths (e.g. tissue), associated beetles and aphids. Berries are valuable food for birds such as thrushes, and flowers are good for pollinating insects (**May–June**).

### Design

**Site characteristics:** Typically a more **minor** component in a range of soils – except for very drought-prone and permanently waterlogged sites – but mainly on moist soils that are generally more acidic (**WU/WL/AL**).

**Structures:** Best within open wooded habitats (**owh**), and transitional habitats as scattered in more open, damp vegetation (**gl**), where its nature recovery contribution can be maximised and it can regenerate.





## Initiate

**Dispersal/natural colonisation:** A pioneer species, spreading through seed dispersal, mainly by birds. Where fruiting populations occur in the area, then consider potential natural colonisation. Can spread easily through suckering, so where it is already present, then support this. Buckthorns form arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Its effectiveness using direct seeding is unknown, but could be trialled. Where natural colonisation is unlikely, then planting may be the best option for establishing this species, using local provenance material sourced and grown in the UK.

## Establish

Although it can tolerate some shade, it will thrive and regenerate as part of open wooded habitats (**owh**) or damp glades (**gl**). Once established, it can also regenerate strongly after cutting or grazing.



TOM TOOKEY/ALAMY STOCK PHOTO

Alder buckthorn and purging buckthorn are the larval foodplants for the brimstone butterfly (*Gonepteryx rhamni*).



FLPA/ALAMY STOCK PHOTO

## Apple, crab/wild (*Malus sylvestris*)

### Ecological characteristics

**Status:** native deciduous tree

**Height:** small (potentially up to 10+ metres)

**Girth:** potentially to 2.5+ metres

**Longevity:** potential to live 150+ years

**Shade:** 2.3

**Drought:** 3.2

**Waterlogging:** 1.7

**Herbivory:** 2.5

**Fertility:** 3.5

**Supports:** nearly 100 leaf-feeding insect species<sup>54</sup>; for example, caterpillars of many moths, including the eyed hawk-moth, green pug, Chinese character and pale tussock. Very good blossom for pollinators/insects (**April–May**), including bees and hoverflies. Hosts mistletoe, and the nutrient-rich bark can be important for mosses and some lichens associated with richer bark. Also a source of winter fruit for animals, including blackbirds, thrushes, mice, voles, foxes and badgers.

### Design

**Site characteristics:** Tolerates a range of soil conditions and pH, but best on richer, deeper soils with some fertility (e.g. **BU/BL**).

**Structures:** As a relatively small tree, crab apple is best suited to establishing as a more **minor** component of open wooded habitats (**owh**), or as individual and more open grown trees in glades and other open vegetation (**gl**), where its functions as provider of nectar, pollen and fruit will be optimised. It won't thrive in denser groves.





## Initiate

**Dispersal/natural colonisation:** Crab apple fruit is usually eaten relatively close to the tree, and seed dispersal by birds and mammals – although possible over some distance – is most likely fairly close (within a few metres) to the parent tree. Apples (*Malus* spp.) form arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Suitability for direct seeding is unknown, but mature fruit with seed could be moved within a site. Where crab apple is not within or very close to a site, and natural colonisation is considered unlikely, then planting will require using local provenance material sourced and grown in the UK.

## Establish

This species will establish best as a component of open wooded habitats and more open grown trees in larger glades (**owh/gl**), so as not to be over-topped and shaded by larger trees. This also optimises its functions as a provider of blossom and fruit.



KIT DAY/ALAMY STOCK PHOTO

Wild apples provide a source of fruit well into the winter for many birds, including migratory thrushes like fieldfare.



BEN LEE/WTMC

## Ash (*Fraxinus excelsior*)

### Ecological characteristics

**Status:** native deciduous tree

**Height:** very large (potentially 35–40 metres)

**Girth:** potentially to 6–8 metres

**Longevity:** can be long-lived (300–800 years)

**Shade:** 2.8

**Drought:** 2.5

**Waterlogging:** 2.7

**Herbivory:** 2.1

**Fertility:** 3.5

**Supports:** nearly 1,000 associated species<sup>34</sup>, 100 of which are only on ash or rarely other species. Many rely on old ash; for example, decay fungi and invertebrates, bats in cavities. Its base-rich bark supports over 550 lichens – smooth when young, rough when old<sup>7</sup>. Good for mosses and liverworts<sup>1</sup>. Airy canopy and early leaf fall allow sunlight to reach the woodland floor, providing conditions for rich woodland ground flora and unique leaf litter. Seeds consumed by birds such as bullfinch.

### Design

**Site characteristics:** A key tree across the UK on more neutral to basic pH soils with a wide range of moisture levels. Appropriate in many wooded habitats of all densities (**gr/wp/gl**), but could be a **major** component of many base-rich and neutral habitats (**BU/BL**) and generally, a more **minor** component of damper soils (**WU/WL**).

**Structures:** Its representation in new wooded habitats will be largely determined through natural processes, with any genetic or field tolerance to the impacts of ash dieback.





## Initiate

**Dispersal/natural colonisation:** Ash regeneration is an important part of adapting to ash dieback. Ash can still be included through natural colonisation, and wind-dispersed seed can be prolific, with most expected to travel within 50–100 metres<sup>14</sup>. Ash forms arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Where natural colonisation is unlikely, direct seeding through local translocation could be considered, but can be vulnerable to seed predation by small mammals, and vegetation must be favourable to seedling survival and growth<sup>21</sup>. Very local translocation of saplings may be appropriate where showing field and potential genetic tolerance to dieback.

## Establish

Perpetuating ash relies on ensuring that genetic or field tolerance is developed. Consider latest advice with ash dieback. It is possible that denser groves of ash have less field tolerance to dieback with higher spore loads. Thinning and maintaining space around ash in open wooded habitats and glades (**owh/gl**) may develop more field tolerance. Although its health is seriously compromised by dieback, it is likely to be resilient to climate change<sup>60</sup>.



The caterpillar of the dusky thorn moth (*Ennomos fuscantaria*) feeds on ash – one of many species that depend on ash.



DANIEL ROMANI/WTM

## Aspen (*Populus tremula*)

### Ecological characteristics

**Status:** deciduous native tree

**Height:** quite large (potentially to around 20–25 metres)

**Girth:** potentially to 1–2 metres

**Longevity:** short-lived (100 years) as individual stems; clonal root systems and suckers may be much older

**Shade:** 2.1

**Drought:** 3.0

**Waterlogging:** 2.1

**Herbivory:** 1.0

**Fertility:** 3.0

**Supports:** (as a food plant) over 220 invertebrate species<sup>13</sup>, including rare insects (e.g. aspen hoverfly). Likely to be a good replacement for some ash characteristics; for example, epiphytes on bark. Very important for lichens, with over 280 species known to occur on its trunks and branches<sup>9</sup>. It also maintains a light canopy, favouring ash-adapted ground flora. Favoured by Eurasian beaver.

### Design

**Site characteristics:** Versatile on range of sites (dry to slightly wet; nutrient poor to rich soils), often moist clay or sandy soils. Moderately tolerant of exposure. Can feature as a **major** or **minor** component of communities (AU/AL/BU/BL/WU/WL).

**Structures:** Particularly as part of more dynamic, open wooded habitats (**owh**), where it can move about through suckering. It can establish in some younger groves (**gr**) where it can maintain a lighter canopy (like ash). Can feature as open grown trees (**gl**).





## Initiate

**Dispersal/natural colonisation:** The production of tiny, fluffy seed in summer can be very limited or rare, but where produced, most travels 100–200 metres by wind<sup>14</sup>. Regeneration is typically vegetative, through suckering. This can be prolific. Aspen forms both ectomycorrhizas and arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding is problematic, as seed is recalcitrant (perishable, short-lived), and planting is typically required where seed is not present. Supply of local provenance stock may be difficult. Local propagation projects can involve root-cutting translocations. Dioecious (male/female flowers on different trees), so ensure both.

## Establish

Highly palatable and intolerant of herbivore impacts, so establishment needs to be where herbivore numbers are low. Intolerant of shade, aspen will establish best in open wooded habitats, allowing it to move around. Maintaining open wooded habitats (**owh**) and glades (**gl**) will support perpetuating aspen. Likely to have relatively high resilience to future climate-change scenarios.



ALASTAIR HOTCHKISS

The lichen *Megalaria pulverea* on aspen bark. Aspen can support rich epiphyte diversity, especially in open wooded habitats and glades.





## Barberry, common (*Berberis vulgaris*)

### Ecological characteristics

**Status:** a spiny, deciduous shrub, probably native to at least parts of England and Wales

**Height:** small (to 4 metres)

**Girth:** shrubby/multi-stemmed

**Longevity:** potentially to 50+ years, and individuals may persist longer by rhizomatous suckering

**Shade:** 1.9

**Drought:** 3.9

**Waterlogging:** 1.4

**Herbivory:** 2.2

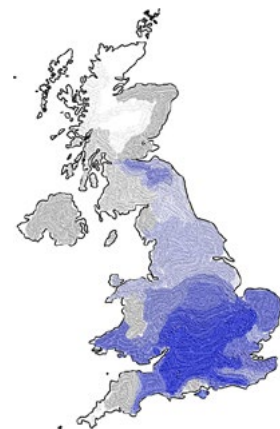
**Fertility:** 1.5

**Supports:** over 20 species of moth alone, including the scarce tissue and barberry carpet moths, particularly in dry, base-rich soils over chalk and limestone in the south. More generally, it is a good flowering source for bumblebees and other pollinators (**May–June**). Fruits are also valuable food for birds.

### Design

**Site characteristics:** A species of typically dry, infertile and base-rich soils (e.g. overlaying chalk in southern England, **BL**). Was subject to a widespread eradication scheme in the 19th century due to it being an alternate host for a rust fungus on wheat. But modern wheat grown now is resistant to stem rust, so re-populating barberry in key areas is acceptable. However, avoid planting within 20 metres of arable fields.

**Structures:** It will be best as a **minor** component of scrub in glades (**gl**) and more sunny open wooded habitats (**owh**).



## Initiate

**Dispersal/natural colonisation:** Bird-dispersed, with berries an important food for many birds which disperse the seeds in their droppings. Where fruiting populations occur in the area, then consider potential natural colonisation. Barberry forms arbuscular mycorrhizas, and associated fungi already occurring in or near a site may support colonisation.

**Direct seeding and/or planting:** It will grow well from seed or cuttings, but direct seeding effectiveness is unknown. This typically necessitates planting, using local provenance material sourced and grown in the UK, possibly through local propagation projects.

## Establish

It can be slow growing, and establishing may require aftercare for the first few years, including removal of competitive vegetation (e.g. bramble, wild clematis). Young plants are browsed by rabbits, deer and livestock, so protect where that is a risk.



The barberry carpet moth (*Pareulype berberata*) is one of many species which rely on common barberry.

ALEX HYDE



BEN LEE/WTML

## Beech (*Fagus sylvatica*)

### Ecological characteristics

**Status:** deciduous, locally native tree  
**Height:** potentially large (40+ metres)  
**Girth:** potentially to 7 metres  
**Longevity:** long-lived (300–500 years)

**Shade:** 4.6

**Drought:** 2.1

**Waterlogging:** 1.0

**Herbivory:** 4.2

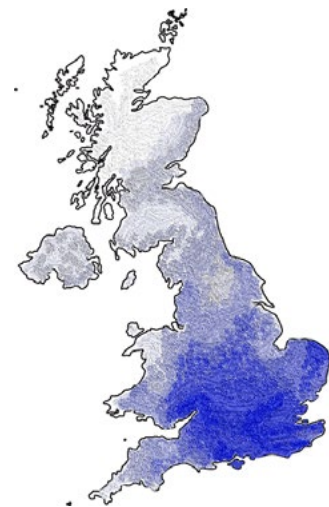
**Fertility:** 3.0

**Supports:** around 100 insect species which feed on its leaves<sup>23</sup>, including barred hook-tip moth. It's also one of the most important trees for associated flies and beetles, and supports a great array of wood-decay invertebrates. Its mast is important food for birds (e.g. bramblings, wood pigeon, chaffinch, jay, nuthatch). Rich fungi include mycorrhiza (e.g. boletes, milkcaps, amanita, webcaps), wood decaying and lichens. Beech-specialist associates are richest in native ancient and old-growth beechwood areas (e.g. New Forest, South and North Downs, Wye Valley, Chilterns, Cotswolds).

### Design

**Site characteristics:** On a range of soil pH (chalks and limestone to acidic geologies) (**AL/BL**). Typically on free-draining soils. Avoid on most compacted, waterlogged or very thin, dry soils. Shallow rooted and intolerant of drought.

**Structures:** Shade tolerant, and can be a **major** or **minor** component of denser groves (**gr**), but can also establish in open wooded habitats and full sun (**owh/gl**), where open grown trees speed up development of larger trees and complex beech microhabitats. Pollards can also accelerate wood-decay habitats.





## Initiate

**Dispersal/natural colonisation:** Most colonisation is expected within 20 metres of seed trees<sup>14</sup>, though some may occur further. Dispersed by mice, jays, squirrels, water. Mastings every 5–10 years, mainly from >40 years old<sup>41</sup>. Beech forms ectomycorrhizas, so associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding is possible, but vulnerable to predation. Although richest in ancient beechwood regions, some beech-associated species occur further north and west where planted and naturalised. In those areas, avoid planting close to ancient woodland where beech is not present. Contributes most where part of better-connected networks with existing quality beech habitats.

## Establish

Can establish with some herbivory. Vulnerable to grey squirrel damage. Where a major component, it can dominate, and other trees and flora lost<sup>43, 63</sup>. Climate change may increase stress in the south<sup>24</sup>. Although this may reduce productivity and competitiveness with other species, individual trees and regeneration could still persist in those areas<sup>33</sup>, continuing to support beech-associated wildlife.



Beech supports a rich array of saprotrophic (wood-decaying) fungi, including the lion's mane or bearded tooth fungus (*Hericium erinaceus*).

## Birch, downy (*Betula pubescens*)

### Ecological characteristics

**Status:** native deciduous tree with a spectrum of hybrids and variation (some areas have distinctive forms or subspecies)

**Height:** medium-sized (to 20+ metres)

**Girth:** potentially to 3 metres

**Longevity:** potential to live 100–200 years

**Shade: 1.8**

**Drought: 1.3**

**Waterlogging: 3.0**

**Herbivory: 3.6**

**Fertility: 2.1**

**Supports:** at least 520 insect species (across all birches), with over 110 entirely dependent<sup>39</sup>, including high aphid biomass as food for birds and insects that feed on aphids or honeydew. Important for many fungi, including ectomycorrhizas (e.g. amanita, boletes, milkcaps, brittlegills, webcaps, rollrim). Decaying snags used for nesting by willow tit. With clean air, it is very important for acid-bark lichens. Masses of seeds are eaten by siskins, greenfinches and redpolls.

### Design

**Site characteristics:** A key species in wooded habitats across the UK. A more **major** component on damper soils (**WU/WL**) than silver birch, but also a **major** or **minor** component on freer-draining soils with higher rainfall (**AU/AL/BU/BL**), tending to be more abundant in the wetter west.

**Structures:** Can occur in dense young groves (**gr**), and self-thinning will create decaying wood. But best in open wooded habitats (**owh**) where they can develop wide crowns and become larger old trees. Open grown trees (**gl**) accelerate this.



## Initiate

**Dispersal/natural colonisation:** Highly pioneering, most colonisation from the large volumes of wind-dispersed seed can be expected within 100–200 metres<sup>14</sup>, but some possible well beyond that. Also moved by animals (e.g. deer, cattle, etc.). Seed produced on even very young trees (5+ years), with a few trees soon supporting more colonisation. Birch forms ectomycorrhizas, and associated fungi in or near to a site may support colonisation.

**Direct seeding and/or planting:** Establishes by direct seeding<sup>64</sup>, using local provenance zone seed, or local translocations. Seed is short-lived, so ground conditions are key for germination and establishment. Typically, patchy exposed mineral soils with limited competition from other plants.

## Establish

Although it can establish as dense thickets and young groves (**gr**) through regeneration and planting, individuals require good crown space in order to persist and develop into mature and veteran trees. So establishment should ensure that some individuals have this space in open wooded habitats (**owh**) or glade situations (**gl**). Younger trees may tolerate more drought than older, larger trees.



Aphid species can be uniquely associated with one tree species. They are ecosystem engineers, supporting predatory insects, birds and honeydew feeders, such as red wood ants (*Formica* spp.).





## Birch, silver (*Betula pendula*)

### Ecological characteristics

**Status:** native deciduous tree with a spectrum of hybrids with downy birch  
**Height:** medium–large (to 25+ metres)  
**Girth:** potentially to 2.5 metres  
**Longevity:** potential to live 100–200 years

**Shade:** 2.1

**Drought:** 1.9

**Waterlogging:** 1.6

**Herbivory:** 3.6

**Fertility:** 2.1

**Supports:** over 520 insect species (across all birches), with over 110 entirely dependent<sup>39</sup>. Can support high aphid biomass as food for birds and insects and those associated with honeydew. Birch are important for many fungi, including ectomycorrhizas (e.g. amanita, boletes, milkcaps, brittlegills, webcaps, rollrim). In regions with cleanest air, it supports acid-bark lichens. Masses of seeds are eaten by siskins, greenfinches and redpolls.

### Design

**Site characteristics:** A key species that could be a **major** or **minor** component of many wooded habitats across the UK, more typical (than downy birch) of drier central and eastern climates on freer-draining soils (**AL/BU/BL**), but deep enough to avoid drought impacts.

**Structures:** Tolerates some denser young groves (**gr**), but will do best and regenerate in open wooded habitats (**owh**) where they can persist and develop. Open grown trees (**gl**) are important for many functions, and accelerate growth to larger trees.



## Initiate

**Dispersal/natural colonisation:** Highly pioneering, most colonisation from the large volumes of wind-dispersed seed is expected within 100–200 metres<sup>14</sup>, and some individuals possibly well beyond. Also moved by animals (e.g. cattle, deer). Seed produced on young trees (5+ years); therefore, a few trees will soon support wider colonisation. Birch form ectomycorrhizas, so associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Birch establishes by direct seeding<sup>64</sup>, using local provenance material, or local translocations. Seed is short-lived, so ground conditions favourable to germination and establishment is key; for example, patchy exposed mineral soils, limited competitive vegetation.

## Establish

It can establish as part of dense thickets and young groves (**gr**) through regeneration and planting, but individuals develop best with good crown space in order to persist and become mature and veteran trees. Establishment is best as part of open wooded habitats (**owh**) or glade structures (**gl**), where more considerable crown space can be maintained. Silver birch is more or less self-incompatible, so seed from isolated trees in otherwise downy-birch-dominated areas will likely be a hybrid.



Birch trees support many ectomycorrhizal fungi, including the orange birch bolete (*Leccinum versipelle*).



## Blackthorn/sloe (*Prunus spinosa*)

### Ecological characteristics

**Status:** spiny, densely branched native shrub or small tree

**Height:** up to 5–6+ metres

**Girth:** potentially to 1.5 metres

**Longevity:** potentially to 50+ years, and individuals may persist longer by suckering

**Shade:** 1.8

**Drought:** 3.5

**Waterlogging:** 1.6

**Herbivory:** 3.5

**Fertility:** 3.5

**Supports:** pollinators early in the year (around **March**) where open conditions enable prolific, highly important blossom for insects, such as solitary bees (e.g. *Andrena varians*)<sup>12</sup>. Fruit important for birds and small mammals in autumn/winter; while the thorny cover provides crucial habitat for nesting and roosting birds. Foodplant for over 109 plant-feeding insects<sup>54</sup>, including black and brown hairstreak butterflies, and many moths (e.g. lackey, magpie, swallowtail). Similar to wild plum/damson/bullace (*Prunus domestica*); probably a part ancestor (ancient hybrid with another *Prunus*).

### Design

**Site characteristics:** Mainly in wooded habitat transitions on a range of drier soils, avoiding very damp sites. Predominately on more base-rich, drier soils (**BU/BL**) and to an extent also some other more neutral to acidic soils (e.g. **AL**).

**Structures:** A **minor** or **major** component of open wooded habitats (**owh**) and more open vegetation and glades (**gl**), where it might be most abundant as scattered, denser patches. Exposure tolerant.





## Initiate

**Dispersal/natural colonisation:** Drupe consumed and seed dispersed by birds, including thrushes, starlings and corvids<sup>39</sup>. The distribution of perches and other shrubs that birds visit will influence where seed moves. It can spread well vegetatively by suckers, often forming dense thickets. Suckering from hedges is likely and should be encouraged. Blackthorn (all *Prunus* spp.) form arbuscular mycorrhizas, and associated fungi already present in or near a site may support colonisation.

**Direct seeding and/or planting:** Its effectiveness using direct seeding is unknown. Where natural colonisation or spread is unlikely due to absence locally, consider planting using local provenance material sourced and grown in the UK.

## Establish

Establishing requires maintaining more open wooded habitats and glade structures (**owh/gl**). This is likely to require some regular cutting management or the role of grazing animals to maintain more open structures.





## Buckthorn, purging (*Rhamnus cathartica*)

### Ecological characteristics

**Status:** deciduous, locally native tree

**Height:** small (potentially up to 5–6 metres)

**Girth:** potentially to 60+ centimetres

**Longevity:** potentially to 70+ years

**Shade:** 1.9

**Drought:** 3.5

**Waterlogging:** 2.2

**Herbivory:** 4.0

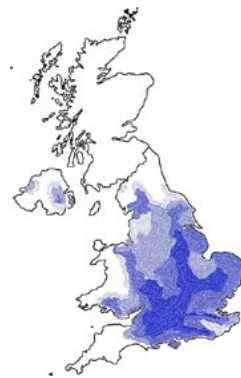
**Fertility:** 3.5

**Supports:** the 45 species of insect known to feed on buckthorn<sup>39</sup>, and is the foodplant for brimstone and green hairstreak butterflies. Berries are consumed by birds in early winter and flowers are good for pollinators in spring (**May–June**). Buckthorn can act as a facilitator of wider colonisation by bird-dispersed trees and shrubs<sup>25</sup>. Seedlings of other species can survive under buckthorn, and horizontal branching provides good perching opportunities for birds.

### Design

**Site characteristics:** Most appropriate in parts of England on calcareous soils (e.g. particularly over limestones or chalk) (mainly **BL**), but can also occur on more base-rich, wet soils, in damp woods and fens (e.g. **WL**).

**Structures:** Typically a relatively **minor** species in more open wooded habitats (**owh**) and scrubby transitions to glades and open vegetation (**gl**).



## Initiate

**Dispersal/natural colonisation:** Berries consumed and seed spread by birds, mainly thrush and starling<sup>39</sup>. Bird-dispersed seed could travel some distance, and where fruiting trees occur in a local area, then natural colonisation could occur where ground conditions are favourable. Perches and other shrubs that birds visit will influence where seed moves to. Buckthorns form arbuscular mycorrhizas, and associated fungi already occurring in or near a site may support colonisation. Consider other factors such as bird-perching opportunities, existing trees/scrub, etc.

**Direct seeding and/or planting:** Its effectiveness using direct seeding is unknown, but could be trialled. Where natural colonisation is unlikely, consider planting with local provenance material sourced and grown in the UK.

## Establish

Buckthorn is dioecious, so establishing both male and female trees will be required to produce seed and future regeneration. Generally free from any significant issues and likely to be relatively robust in the face of rapid climatic changes<sup>16</sup>. But to persist and regenerate, it will require open wooded habitats (**owh**) and glade structures (**gl**) to be maintained.



BUITEN-BEELD/ALAMY STOCK PHOTO

The plant bug *Miris striatus* on buckthorn. Predatory plant bugs like this feed on the aphids, moths and beetles that depend on trees and shrubs.





## Cherry, bird (*Prunus padus*)

### Ecological characteristics

**Status:** deciduous shrub or small, locally native tree  
**Height:** up to 10–15 metres  
**Girth:** potentially to 1 metre  
**Longevity:** relatively short-lived to 100+ years as individual stems, although adventitious root systems may mean individuals persist through vegetative spread and could be much older.

**Shade:** 3.3

**Drought:** 1.9

**Waterlogging:** 3.2

**Herbivory:** 4.0

**Fertility:** 3.8

**Supports:** pollinators in spring (around **April**) as a highly important blossom source where there is enough light to support prolific flowering. Ripe fruit in summer (earlier than many other tree and shrub fruits) is an important food for birds such as thrushes, as well as for wood mice, yellow-necked mice and dormice. Larval foodplant for numerous insects, including caterpillars of moth species like bird-cherry ermine.

### Design

**Site characteristics:** Moist, wooded habitats, particularly near watercourses and other damp – sometimes rocky – situations. Most frequent on damp calcareous or base-rich substrates in the north and west (**BU/WU**) where typically a more **minor** component, and avoiding the very dry or very acidic soils.

**Structures:** It will thrive best in open wooded habitats (**owh**) and potentially as scattered individuals in glades (**gl**). Consider its potential for vegetative spread and risks to any adjacent open habitat features in designs.



## Initiate

**Dispersal/natural colonisation:** Vegetative spread through layering and adventitious root suckering can be prolific, forming thickets. Where it occurs, then support establishment through vegetative spread. Might appear at least 20 metres from parent tree. Bird-dispersed seed could travel further distance. Main dispersers are thrushes and some smaller birds, such as robin and warblers<sup>39</sup>. Consider bird-perching opportunities, other shrubs, etc. All *Prunus* species form arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Effectiveness with direct seeding is unknown, but could be trialled. Planting requires local provenance material sourced and grown in the UK.

## Establish

Regenerating and perpetuating this species is likely to require areas of more dynamic open wooded habitats (**owh**) and damper glades (**gl**). Foliage is toxic to browsing animals, particularly goats, and it may be possible to establish bird cherry with some herbivore presence.



The bird cherry ermine moth (*Yponomeuta evonymella*) caterpillars are concealed inside web-like nests on bird cherry.

ALASTAIR HOTCHKISS



ADRIAN DAVIES/NATUREPL.COM

## Cherry, wild (*Prunus avium*)

### Ecological characteristics:

**Status:** deciduous native tree

**Height:** potential to get quite large (25+ metres)

**Girth:** potentially to 3.5+ metres

**Longevity:** relatively short life (100+ years)

**Shade:** 3.3

**Drought:** 2.7

**Waterlogging:** 1.2

**Herbivory:** 3.0

**Fertility:** 3.5

**Supports:** pollinators in spring (around **April**) with its highly important canopy blossom source. Its relatively short life can support provision of snags (standing decaying wood) of value to wood-decay invertebrates and cavity-dwelling birds. Fruits eaten by many birds (e.g. hawfinch, bullfinch, greenfinch, wood pigeon and tits) and are an important relatively early fruit in summer (**July–August**). Some disperse these, while others are mainly seed predators. Known foodplant for 80 insect species<sup>13</sup>, mainly moths, beetles and true bugs.

### Design

**Site characteristics:** On deeper, richer and relatively moist soils, not waterlogged or frequently droughted. Range of soil pH (calcareous, neutral or acidic) so long as they are not very infertile (mainly **BL/AL**, some **BU**). Typically a **minor** component, but can be locally frequent.

**Structures:** Flowering, fruiting and regeneration will be optimised in more dynamic, open wooded habitats (**owh**), but can establish as a **minor** component of young groves (**gr**), and as open grown trees in glades (**gl**), but only on sheltered sites. Not tolerant of exposure.





## Initiate

**Dispersal/natural colonisation:** A species which can move around to take advantage of gaps and clearings through suckering and clonal spread. Bird-dispersed seed also allows for longer dispersal, mainly by thrushes and wood pigeon<sup>39</sup> and could travel some distance, though most occurs within 50 metres of parent tree<sup>45</sup>. Consider bird-perching opportunities, existing trees, etc. All *Prunus* species form arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation. Suckering from existing trees can be prolific, and should be encouraged.

**Direct seeding and/or planting:** Where natural colonisation is unlikely, consider planting using local provenance material, sourced and grown in the UK.

## Establish

Relatively fast growing, strong apical growth. Flowers and seeds from around 10 years. Pollination requires more than one individual. Avoid pruning as this can lead to silverleaf, which can be damaging or fatal. Encourage suckers by maintaining open wooded habitats (**owh**) and glades (**gl**). High levels of genetic variation; likely to be able to respond and adapt to changing climate, but may suffer increased drought stress in some southern sites<sup>15</sup>.





## Dogwood (*Cornus sanguinea*)

### Ecological characteristics

**Status:** deciduous, locally native shrub

**Height:** up to 6–7 metres

**Girth:** potentially to 50 centimetres, though typically much branched

**Longevity:** potentially to 60+ years, though individuals may persist longer by suckering

**Shade: 1.9**

**Drought: 3.0**

**Waterlogging: 1.9**

**Herbivory: 2.5**

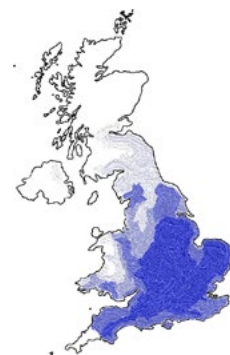
**Fertility: 3.5**

**Supports:** around 65 species of insect which feed on dogwood<sup>39</sup>, including green hairstreak and holly blue butterflies. Good blossom for pollinators (**May–July**). Dogwood can act as a facilitator of wider colonisation by bird-dispersed trees and shrubs<sup>25</sup>. Seedlings of other species can survive under dogwood, and horizontal branching provides good perching opportunities for birds. Fruits particularly favoured by starlings, thrushes and robins.

### Design

**Site characteristics:** Particularly on well-drained and more calcareous soils (**BL**) in central and southern England.

**Structures:** A typically **minor** species to include in open wooded habitats (**owh**) and transitions to glades and scattered scrub within more open vegetation (**gl**). It will not tolerate shade, so don't include in groves, although edges with more managed open space (e.g. paths) may be appropriate.



## Initiate

**Dispersal/natural colonisation:** Drupe consumed and seed dispersed by birds, primarily by thrush, starling, robin and corvids<sup>39</sup>. The distribution of perches and other shrubs that birds visit will influence where seed moves. Dogwood forms arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Dogwood can also be established from cuttings and layering. Its effectiveness using direct seeding is unknown, but could be trialled. Where natural colonisation is unlikely, consider planting with local provenance material, sourced and grown in the UK.

## Establish

Generally, dogwood has few issues to establishment, so long as it occurs in more open or sunny spots. It is relatively tolerant of drought; however, browsing and fraying activity by deer can sometimes prevent trees from establishing well.



ALASTAIR HOTCHKISS

Many leaf-mining flies and moths rely on just one tree or shrub species. *Phytomyza agromyzina* is a fly which specialises by mining dogwood leaves.





BEN LEE/WTML

## Elder (*Sambucus nigra*)

### Ecological characteristics

**Status:** deciduous native shrub

**Height:** to 5–7 metres

**Girth:** potentially to 1.5 metres

**Longevity:** short-lived (<70 years, exceptionally 100+ years)

**Shade:** 2.3

**Drought:** 3.0

**Waterlogging:** 1.7

**Herbivory:** 3.0

**Fertility:** 4.0

**Supports:** birds (thrushes, wood pigeon, bullfinch, tits, blackcap, whitethroats) and mammals, such as dormice and voles, with late summer fruits. Trunks are important for mosses favouring nutrient-rich bark<sup>18</sup>. Thirty-six insect species feed on elder leaves and stems, etc.<sup>2</sup>; aphids can be abundant as food and honeydew providers. Important flowers (**June–July**) for many insects, including bees, flies and beetles. It supports an array of fungi, and hollowed stems, and pithy twigs are used by solitary wasps, bees and overwintering insects.

### Design

**Site characteristics:** On highly fertile soils (mainly **BL/BU**).

**Structures:** It will not thrive in denser, shady groves. Elder can be represented as a typically **minor** component of more open wooded habitats (**owh**) and a **minor** or potentially **major** component of fertile, open glades (**gl**), as scattered trees and scrub.



## Initiate

**Dispersal/natural colonisation:** In areas where elder already occurs, then natural colonisation is likely and the distribution of perches and other shrubs that birds visit will influence where seed moves. Drupe consumed by birds, with the main dispersers being thrushes, starling, blackcap, warblers, corvids<sup>39</sup>. Elder forms arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation. Unpalatable to rabbits, but palatable to deer<sup>2</sup>.

**Direct seeding and/or planting:** Elder's effectiveness using direct seeding is unknown, but could be trialled. Where not present locally, and natural colonisation is considered unlikely, then all planting must be of UK sourced and grown nursery stock from local provenance.

## Establish

Elder establishes best in open wooded habitats (**owh**) and sunnier glades (**gl**). However, unlike most native trees and shrubs, elder can form persistent seed banks and can germinate when conditions become favourable many years after they have been deposited<sup>2</sup>. Coppicing elder can prolong individuals' otherwise fairly short life<sup>16</sup>. Elder is a robust species and currently has few significant issues.



The jelly ear fungus (*Auricularia*) and mosses on elder. Many mosses favour elder's moisture-retentive and nutrient-rich bark.



## Elm, wych (*Ulmus glabra*/*U. scabra*)

### Ecological characteristics:

**Status:** deciduous native tree (elm taxonomy is complex, but two large-leaved wych elms are *U. glabra* [mostly northern and western] and *U. scabra* [mainly in south and east]<sup>51</sup>)

**Height:** can be large (30+ metres), but most persist as small individuals due to Dutch elm disease

**Girth:** potentially to 5+ metres

**Longevity:** long-lived (300+ years)

**Shade:** 3.5

**Drought:** 2.4

**Waterlogging:** 2.0

**Herbivory:** 1.2

**Fertility:** 3.5

**Supports:** 100 insect species which feed on its leaves. Old trees support base-rich bark lichens, and wood-decay fungi and mosses<sup>1</sup>. Earthworms favour elm leaf litter. Flowers (from **Feb–April**) and visited by many insects<sup>58</sup>. Early seeds (**April–July**) for bullfinch, greenfinch, siskin, goldfinch, hawfinch and tree sparrows<sup>58</sup>.

### Design

**Site characteristics:** Mostly now a **minor** component on more neutral to alkaline soils, often where they retain some moisture (which could be due to high rainfall) (**BU/BL/WU/WL**).

**Structures:** Wych elm can be included across all densities, and tolerates being part of denser, shadier groves (**gr**), through to individual scattered and open grown trees (**owh/gl**). Representing elm in all these structures will maximise contribution to nature recovery, and sunlit elms are important for associated species.





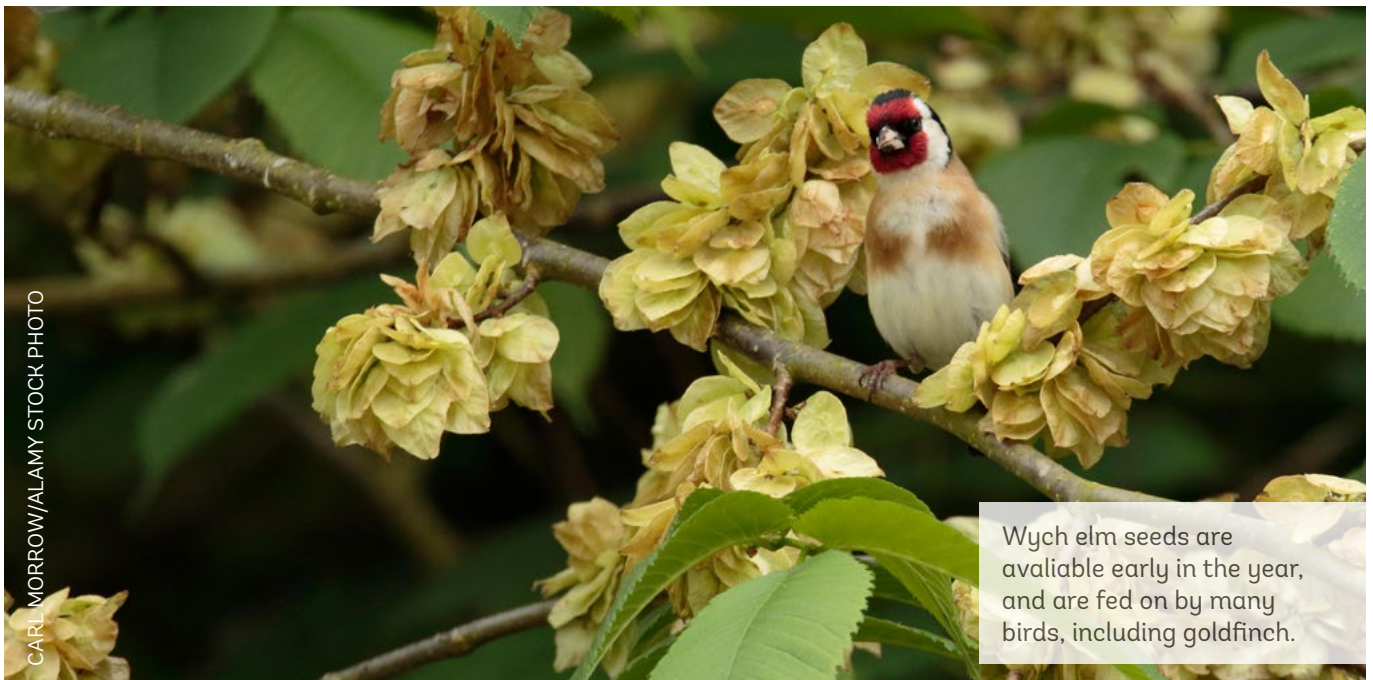
## Initiate

**Dispersal/natural colonisation:** Seeds are wind-dispersed, falling in April to July, but are short-lived, being viable only for a few days. Production not always reliable, but where produced expect most colonisation within 100 metres<sup>14</sup>, and seedling establishment can be abundant<sup>58</sup> where conditions are favourable. Forms arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation. Highly sensitive to browsing, including deer and livestock, so regeneration is unlikely with high herbivore pressures, unless protected; for example, by thorny scrub.

**Direct seeding and/or planting:** Direct seeding effectiveness unknown. Plant only local provenance because of variation with wych elm and elm microspecies.

## Establish

Establishment will require low herbivore impacts. It is shade tolerant. The health and survival of wych elm has been seriously compromised since the 1970s due to Dutch elm disease. Many elms are reduced to small trees regrowing from basal sprouts or seeds. Fortunately for its long-term survival, seed production usually begins a number of years before they are reinfected.





BRIAN LEGG/WTML

## Guelder rose (*Viburnum opulus*)

### Ecological characteristics:

**Status:** deciduous native shrub  
**Height:** fairly small (up to 4 metres tall)  
**Girth:** shrubby/multi-stemmed  
**Longevity:** potentially to 50+ years

**Shade:** 2.7  
**Drought:** 2.2  
**Waterlogging:** 2.1  
**Herbivory:** 2.5  
**Fertility:** 3.5

**Supports:** insects in spring (**May–June**) as a good blossom source, particularly droneflies, other hoverflies and beetles<sup>26</sup>. Fruits are not highly attractive to birds (often remaining on the bush into winter), but are eaten by birds (robin, thrushes, blackcap, bullfinch). About 30 insect species feed on its leaves<sup>26</sup>, including various aphids, beetles, and yellow-barred brindle moth. The impressive, but elusive, orange-tailed clearwing moth feeds for two years as larvae in the stems of guelder rose and wayfaring tree. Aphid biomass can be high, supporting many other species.

### Design

**Site characteristics:** Typically a relatively **minor** component, mainly on neutral to calcareous soils, where it does best in somewhat damper places (**WU/WL/BL**), and to a lesser extent on some slightly acidic soils on deeper, moist, brown earths (**AL**).

**Structures:** Guelder rose is best represented across open wooded habitats and edges of glades (**owh/gl**). While somewhat tolerant of shade and could occur in some groves (**gr**), its contribution as a source of blossom and fruit will not be provided by non-flowering bushes in shade.



## Initiate

**Dispersal/natural colonisation:** Drupe consumed and seed spread by birds, including thrushes, robin, blackcap<sup>39</sup>. Consider presence of existing shrubs as facilitators (e.g. hawthorn, dog roses), other perching opportunities, and proximity to fruiting guelder rose. *Viburnum* species form arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation. Where established individuals occur within a site, then can form adventitious roots and spread by layering and suckering.

**Direct seeding and/or planting:** Its effectiveness using direct seeding is unknown. Where natural colonisation is unlikely, consider planting using local provenance material, sourced and grown in the UK.

## Establish

Ultimately, although persisting as non-flowering bushes in shade, reproduction and seed production will occur in more open wooded habitats (**owh**)<sup>26</sup>. Can regrow very well from being cut. Can be palatable to deer and moderately palatable to rabbits. Could be heavily defoliated, but otherwise relatively few significant issues. Increasing drought may be an issue in some parts with climate change; for example, on clays in the southeast<sup>16</sup>.



The berries of guelder rose can remain into the winter, providing food for small mammals like yellow-necked mouse.





BEN LEE/WTML

## Hawthorn (*Crataegus monogyna*)

### Ecological characteristics

**Status:** deciduous native shrub or small tree  
**Height:** to 15+ metres  
**Girth:** potentially to 2 metres  
**Longevity:** 200+ years (potentially)

**Shade:** 1.9  
**Drought:** 3.5  
**Waterlogging:** 1.7  
**Herbivory:** 3.0  
**Fertility:** 3.0

**Supports:** over 350 plant-feeding insect species<sup>39</sup>. The fruit is very important for birds, especially thrushes. Dense, thorny cover for nesting/roosting. Very important flowers for insects (around **May–June**). Many flies and beetles feed on the flowers, having lived as larvae in decaying wood. Well-lit twigs are good for acid-bark lichens. Highly important facilitator of colonisation by other trees and shrubs<sup>25</sup>. Horizontal branching provides perching for birds. Seedlings of many species survive under it, and thorns protect it from browsing animals.

### Design

**Site characteristics:** A key shrub for all parts of the UK on a range of relatively dry soils (**AU/AL/BU/BL**).

**Structures:** Its contributions of blossom and fruit is maximised by hawthorn as open grown individuals or groups as a **major** or **minor** component of more open wooded habitats and glades (**owh/gl**). It is exposure tolerant, establishing well in very open situations. Prolific flowering and longevity will be much reduced with shade, so avoid in groves. Avoid planting in areas very close to ancient woodland supporting grove/Midland hawthorn, as hybridisation can result.



## Initiate

**Dispersal/natural colonisation:** Good potential for natural colonisation where fruiting trees occur in an area, and there are existing perching opportunities or other fruiting shrubs for birds and favourable ground conditions. Bird-dispersed seed is mainly by thrushes, starling and wood pigeon<sup>39</sup>. Hawthorns form arbuscular mycorrhizas, and associated fungi occurring in or near a site may support colonisation. They may also expand out from hedges.

**Direct seeding and/or planting:** Its effectiveness using direct seeding is unknown, although seeds do require a lengthy period of stratification. Where natural colonisation is unlikely, then consider planting. Local provenances are important and can be critical to phenology and associated insects.

## Establish

The main factors ensuring good establishment will be maintaining enough space and light in open wooded habitats and glades (**owh/gl**). Relatively tolerant of drought and herbivory. Hawthorn appears to have very few issues and is likely to be fairly resilient to many climate-change impacts.



Hawthorn blossom is vital for hundreds of insects, including many that live in decaying wood or leaf mould as larvae, such as the rose chafer beetle (*Cetonia aurata*).





## Hawthorn, grove/Midland (*Crataegus laevigata*)

### Ecological characteristics

**Status:** deciduous, locally native shrub or small tree

**Height:** up to around 7–10 metres

**Girth:** potentially to 1.5–2 metres

**Longevity:** 150+ years (potentially)

**Shade:** 2.6

**Drought:** 2.9

**Waterlogging:** 1.1

**Herbivory:** 3.0

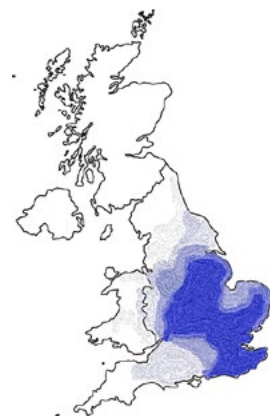
**Fertility:** 3.0

**Supports:** over 50 associated insect species, but there are likely to be more that are shared with common hawthorn. Unlike common hawthorn, flowers are readily produced in more shaded conditions (**April–May**), and may be an important nectar and pollen source for some flies or beetles in shadier groves. Fruit is eaten and dispersed by birds, including blackbird, thrushes and tits.

### Design

**Site characteristics:** It can tolerate a wide range of soils, but is best on heavier, neutral clay or loamy soils (e.g. **BL**). It has a distinctive biogeography associated with ancient woodlands in parts of the southern half of the UK, particularly in the Midlands and southeast England<sup>59</sup>.

**Structures:** It is more shade tolerant than *C. monogyna* and could be established in some denser groves (**gr**) as well as open wooded habitats (**owh**). A relatively **minor** component as infrequent scattered individuals, rather than groups or thickets like common hawthorn.





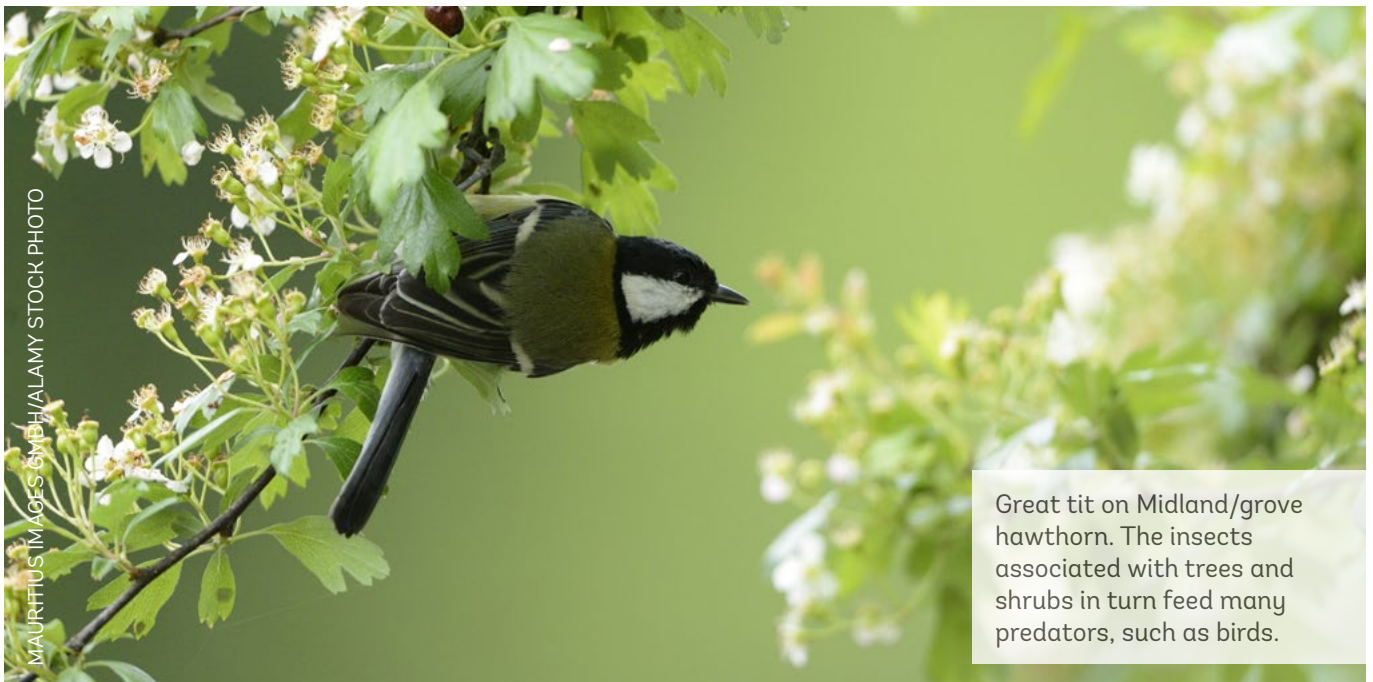
## Initiate

**Dispersal/natural colonisation:** Seed dispersed by birds and possibly small mammals. Given its association with ancient woodlands and distinctive biogeography, it should primarily be established through local seed collection projects, especially where a project is close to ancient woodland with this species. Hawthorns form arbuscular mycorrhizas, and associated fungi occurring in or near a site may support colonisation.

**Direct seeding and/or planting:** Its effectiveness using direct seeding is unknown. Planting will require ensuring local provenances, and it may be most appropriate to consider local propagation projects for this species within core areas in central and southeast England.

## Establish

It can establish as part of denser young groves. It can hybridise with common hawthorn<sup>59</sup>, but this may be least likely where it occurs in groves that are maintained as relatively shady.



Great tit on Midland/grove hawthorn. The insects associated with trees and shrubs in turn feed many predators, such as birds.



## Hazel (*Corylus avellana*)

### Ecological characteristics

**Status:** a deciduous native shrub

**Height:** up to 10 metres

**Girth:** typically multi-stemmed, but stems potentially over 1 metre

**Longevity:** 200+ years (potentially)

**Shade:** 3.5

**Drought:** 3.0

**Waterlogging:** 1.7

**Herbivory:** 2.1

**Fertility:** 3.5

**Supports:** over 250 insect species which are known to specialise by feeding on hazel, including hazel-leaf roller weevil. Good early (**March**) blossom source for pollinators/insects, with pollen on catkins supporting early bumblebees and solitary bees such as Clarke's mining bee (*Andrena clarkella*). Important foodplant for caterpillars of many moth species. Very important for smooth-barked lichens, especially in more humid and high-rainfall areas with relatively clean air (supporting some species currently hosted by ash). Its nuts are an important food for birds like nuthatch, and small mammals, such as dormice.

### Design

**Site characteristics:** Providing key resources and structure as a **major** or **minor** component on a range of soils from base-rich and neutral (**BL/BU**), to mildly acidic soils (some **AU/AL**). Tolerating moist, but not waterlogged soils, it can also occur on some drier and shallower rocky soils.

**Structures:** Relatively shade tolerant, and persists in groves (**gr**), but seed production and regeneration benefit from light, so consider it as part of open wooded habitats (**owh**) and glades (**gl**), where it can establish in exposed situations.



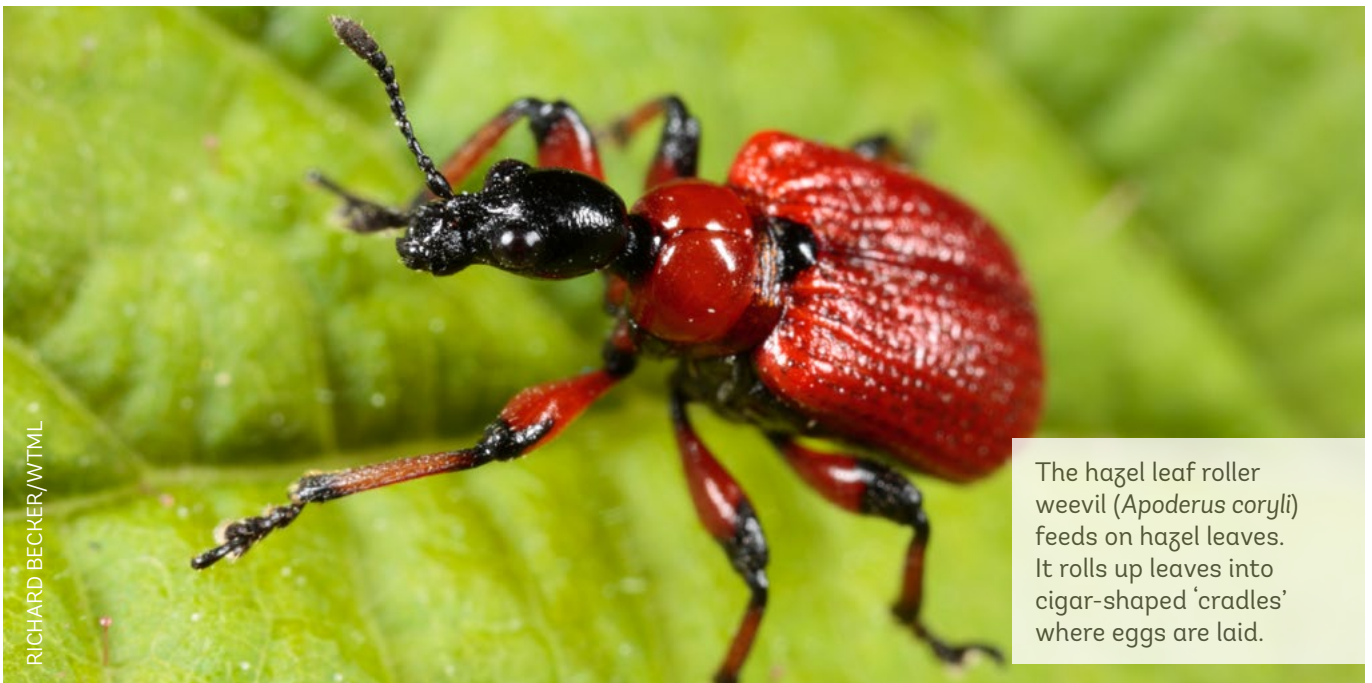
## Initiate

**Dispersal/natural colonisation:** Hazels that are producing nuts will support most natural colonisation to around 20–30 metres<sup>14</sup>, with some potentially further. Hazel forms both arbuscular and ectomycorrhizas, and so any associated fungi (e.g. milkcaps, boletes, etc.) already occurring in or near a site may support colonisation. It can also sucker, and should be encouraged where occurring in hedges or within the site.

**Direct seeding and/or planting:** Direct seeding hazel, as with oak, is likely to be vulnerable to seed predation, and probably benefits from getting seed into the ground. Where natural colonisation is unlikely, consider planting using local provenance material, sourced and grown in the UK.

## Establish

May be difficult to establish with persistently high herbivore impacts. Although it can establish in relatively shady conditions, it is a pioneering tree and will thrive with more dynamic, open wooded habitats (**owh**) where space and light are more freely available. Flowering, nut production and future regeneration will be optimised in these more open situations. Once established, it responds very well to being cut.



The hazel leaf roller weevil (*Apoderus coryli*) feeds on hazel leaves. It rolls up leaves into cigar-shaped 'cradles' where eggs are laid.

RICHARD BECKER/WTML





## Holly (*Ilex aquifolium*)

### Ecological characteristics

**Status:** Evergreen, much-branched, and fairly slow-growing native broadleaved tree

**Height:** to 15+ metres

**Girth:** potentially to 2+ metres

**Longevity:** 200+ years (potentially)

**Shade:** 3.5

**Drought:** 3.0

**Waterlogging:** 1.7

**Herbivory:** 2.1

**Fertility:** 2.5

**Supports:** many bees and hoverflies with its excellent spring blossom (mainly around **April–May**, but can flower at other times). Berries are an important food for birds such as thrushes, woodpigeon, finches and robin. A single twig may bear more than 50 berries<sup>42</sup>. In otherwise deciduous woods, evergreen holly is important for bird roosting and specialist invertebrates. Deep, persistent leaf litter is used by hedgehogs, other mammals and many slime mould species. Holly-feeding insects include leaf-mining flies and holly blue butterfly. Lichens of acidic smooth bark include holly pinhead (*Stenocybe septata*).

### Design

**Site characteristics:** On more well-drained acidic (**AU/AL**) to neutral soils (**BU/BL**) typically. Most frequent in the milder, less frost-prone west.

**Structures:** It features as more open grown trees and is exposure tolerant (**gl**). But it is a relatively shade-tolerant species and more typically a **minor** component of denser groves (**gr**) and open wooded habitats (**owh**).



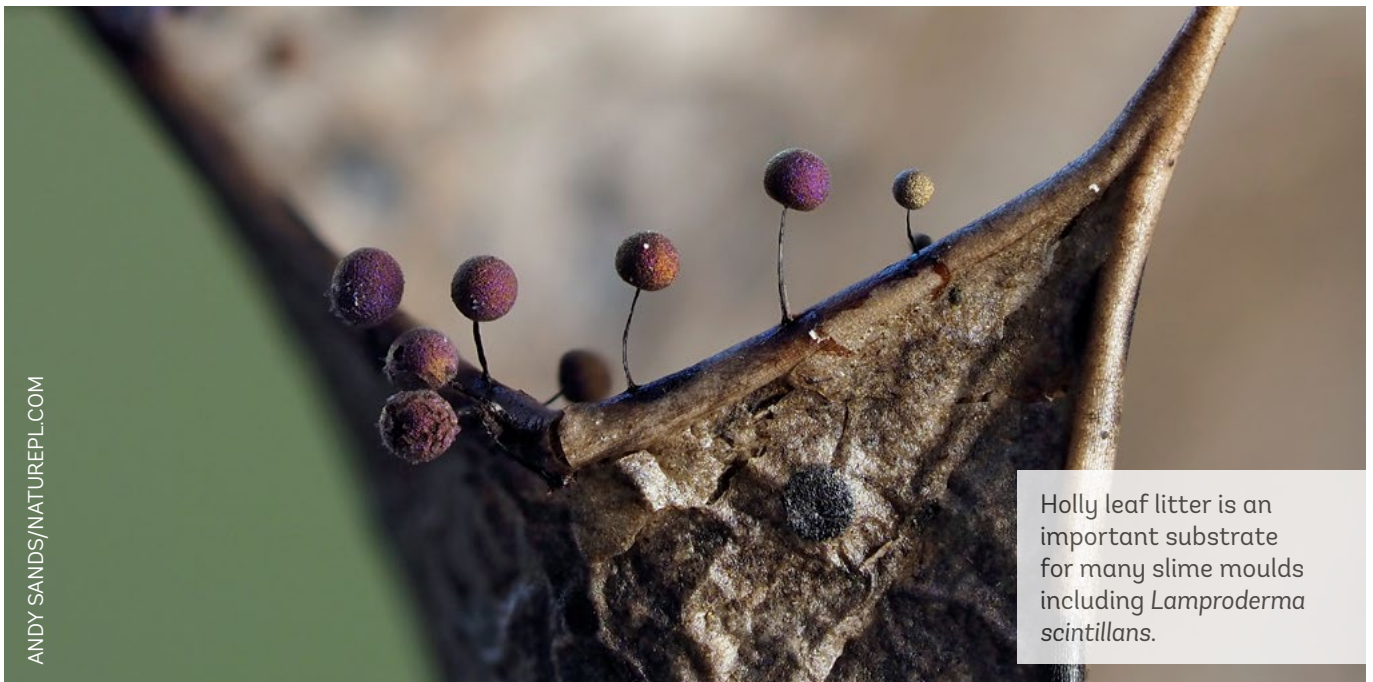
## Initiate

**Dispersal/natural colonisation:** Bird-dispersed seed may result in fairly long-distance transport within areas where fruiting holly occurs. The presence of other fruiting shrubs and perches visited by birds will influence where seed moves. Thrushes are important dispersers, and to a lesser extent, birds such as woodpigeon, blackcap and robin. Holly forms arbuscular mycorrhizas, and any associated fungi already occurring in or near a site may support colonisation.

**Direct seeding and/or planting:** Its effectiveness using direct seeding is unknown, but germination can be slow. Where natural colonisation is unlikely, consider planting using local provenance material, sourced and grown in the UK.

## Establish

Holly is sensitive to grazing and high herbivore impacts, so establishment will require relatively low herbivore impacts to be maintained. It is shade tolerant, and can regenerate within other scattered dense scrub or bushes. There are no significant threats or other issues for holly currently.



Holly leaf litter is an important substrate for many slime moulds including *Lamproderma scintillans*.



## Hornbeam (*Carpinus betulus*)

### Ecological characteristics

**Status:** deciduous, locally native broadleaved tree

**Height:** fairly slow growing, but can reach 25+ metres

**Girth:** potentially to 4–5+ metres

**Longevity:** potential to reach 400+ years

**Shade:** 4.0

**Drought:** 2.7

**Waterlogging:** 1.7

**Herbivory:** 2.5

**Fertility:** 3.5

**Supports:** over 170 species of associated plant-feeding insects<sup>13</sup>, with a few hornbeam specialists, including the caterpillars of a number of micromoth species. Finches (including hawfinch), tits and small mammals eat the seeds in autumn. Supports a wide range of ectomycorrhiza (e.g. webcaps, milkcaps, brittlegills and a rare bolete) and wood-decay fungi. Can retain some brown leaves through winter, providing shelter, roosting, nesting and foraging opportunities for birds.

### Design

**Site characteristics:** Typically on fairly base-poor, but relatively fertile sandy or loamy clays, or clay-with-flints, particularly in southeast England (**BL**). It is intolerant of infertile or exposed sites.

**Structures:** A shade-tolerant species which is typically a relatively **minor** component of denser groves (**gr**), but it can feature in sheltered open wooded habitats (**owh**) and open grown trees in sheltered spots (**gl**), where growth rates can be accelerated into larger trees, and where pollarding could accelerate wood-decay habitat provision.





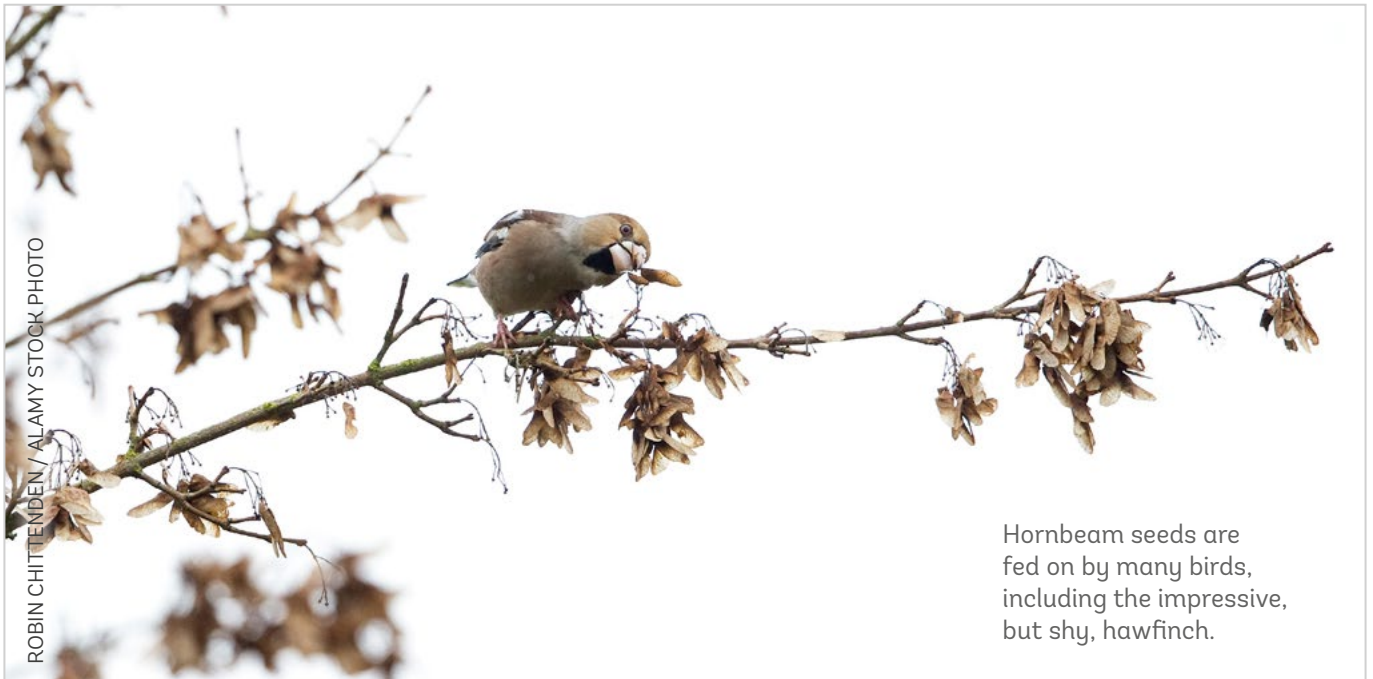
## Initiate

**Dispersal/natural colonisation:** Most regeneration from wind-dispersed seed is expected within 100 metres<sup>14</sup>. But it is not a pioneering species, and doesn't thrive in exposed sites. Colonisation may be closer to existing woods, compared to, for example, birch, oak and hawthorn colonising further out<sup>46</sup>. It forms ectomycorrhizas, and associated fungi in or near a site may support colonisation. Fairly shade tolerant and can regenerate in groves and perhaps scrub.

**Direct seeding and/or planting:** Direct seeding may be an option. It has relatively small seeds that are easy to store/long-lived, but require a long period of cold to germinate, perhaps two winters<sup>52</sup>. Where colonisation is unlikely, plant using local provenance material.

## Establish

Can be slow growing, and aftercare may be needed to support establishment. Less favoured by deer, but can be vulnerable to squirrels. Its shade tolerance means that there are no concerns about maintaining light and space. But once established, it can be pollarded, and these trees would need to be maintained in more open situations. It has few significant issues and a potentially expanding climate space in future<sup>11</sup>.



Hornbeam seeds are fed on by many birds, including the impressive, but shy, hawfinch.

ROBIN CHITTENDEN / ALAMY STOCK PHOTO



## Juniper (*Juniperus communis*)

### Ecological characteristics

**Status:** evergreen, locally native coniferous shrub or small tree  
**Height:** to 10+ metres  
**Girth:** potentially to 1+ metres  
**Longevity:** potentially living for 150–200+ years

**Shade:** 1.7

**Drought:** 4.4

**Waterlogging:** 2.1

**Herbivory:** 2.9

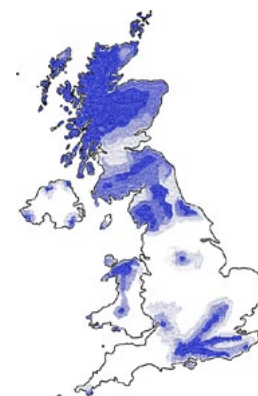
**Fertility:** 1.5

**Supports:** around 65 insect species feeding on juniper leaves and plant material, with 25 specialists on juniper<sup>39</sup>, including juniper shieldbug, juniper carpet moth and juniper aphids, which are sometimes attended by red wood ants for honeydew. Fruit is important for birds – thrushes in particular – and when mature, its dense evergreen cover can provide important nesting and roosting sites for birds such as goldcrest and black grouse.

### Design

**Site characteristics:** Typically drier and freely draining soils, ranging from base-rich (e.g. **BU**, and over chalks **BL**) to acidic, rocky soils (**AU**), so long as they are infertile. These geologies partly define where it is appropriate to consider juniper as part of projects.

**Structures:** Typically a **minor** (sometimes **major**) component in glades and open vegetation (**gl**), and as scattered individuals in open wooded habitats (**owh**). Proximity of a project site to existing native populations must inform initiation.



## Initiate

**Dispersal/natural colonisation:** Seed mainly distributed by birds, particularly thrushes<sup>39</sup>. It forms arbuscular mycorrhizas, and any associated fungi already occurring in or near a site may support colonisation. Juniper is suffering from the pathogen *Phytophthora austrocedri*, which is having serious detrimental impacts on some UK populations.

**Direct seeding and/or planting:** Sites adjacent to or including populations of native juniper should be managed to support natural regeneration and colonisation. Elsewhere, it is vital that any juniper planting is from local provenances with recorded locations, propagated from seed or cuttings with strict biosecurity processes. If this cannot be ensured or demonstrated, then planting is best avoided.

## Establish

Juniper is slow growing, and although it may not be highly palatable, it is not very resilient to responding from browsing damage. A balance is required between herbivore impacts and sufficient light in open wooded habitats, glades and other more open vegetation (where it is not outcompeted by denser birch or rowan, for example). It may also germinate and colonise sites where the ground vegetation is disturbed, and some exposed soils. Flowering and seed production can begin at a young age (8–10 years), and it is dioecious (male and female flowers on different plants).







## Lime, small-leaved (*Tilia cordata*)

### Ecological characteristics

**Status:** deciduous native tree  
**Height:** can get large (30+ metres)  
**Girth:** potentially to 6–7 metres  
**Longevity:** long-lived (800+ years)

**Shade:** 4.2

**Drought:** 2.8

**Waterlogging:** 1.8

**Herbivory:** 1.9

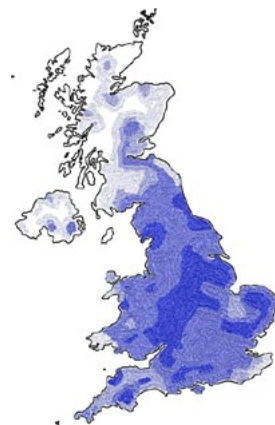
**Fertility:** 2.5

**Supports:** over 110 insects as a foodplant, including scarce hook-tip moth, and high aphid biomass as prey for other insects and birds and honeydew feeders. Excellent summer blossom (**June–July**) for insects. Trees in dense groves may have less aphid biomass<sup>44</sup>. Other high biomass insects include winter moth, which supports many birds; for example, willow warbler<sup>44</sup>. Decaying lime is important for stag beetle, click beetles, and longhorn beetles. Decay fungi include many white-rot species (similar to, for example, ash and elm). Leaf litter rapidly returns to soil by earthworms.

### Design

**Site characteristics:** On a wide range of soils, from freer draining to heavier clay, but mainly on neutral to slightly acidic soils over fairly calcareous geologies, and notably rare on chalk and oolitic limestones (**AL/BL**, some **AU/BU**, e.g. in Wales)<sup>44</sup>.

**Structures:** Characteristic of ancient woods. Shade tolerant and can be established as a **major** (e.g. in core areas) or **minor** component of groves (**gr**), but also important to develop more open grown individuals (**owh/gl**). Pollards can accelerate wood-decay habitats.



## Initiate

**Dispersal/natural colonisation:** Most colonisation from wind-dispersed seed occurs within 100 metres<sup>14</sup>, but viable seed is sometimes not produced and requires a critical period of warmth (June–July). Open grown trees produce flowers from 12–20 years, but in denser groves this may be 30–40 years<sup>44</sup>. Lime forms ectomycorrhizas, and associated fungi may support colonisation when present.

**Direct seeding and/or planting:** Where colonisation is limited, it is vital that planting does not degrade the high genetic diversity and distinctiveness of native small-leaved lime populations<sup>30</sup>, and their historical context. Where close to ancient woods containing small-leaved lime, local propagation projects will be most appropriate.

## Establish

Once established, lime has a strong capacity for vegetative regrowth: it is robust to cutting and windblow and rapidly grows back. Browsing animals and voles can have significant impacts. Likely to be relatively resilient with climate-change impacts. Although it may share some functions with ash (e.g. wood decay), it can cast deep shade from branching structure, and in dense groves it may not support some ash-associated flora, and may exclude more light-demanding trees and shrubs.



TRISTAN BANTOCK

The lime leafhopper (*Pediopsis tiliae*) feeds on lime trees (*Tilia*), particularly small-leaved lime.



## Lime, large-leaved (*Tilia platyphyllos*)

### Ecological characteristics

**Status:** deciduous, locally native tree

**Height:** individuals can potentially become very large (30+ metres)

**Girth:** potentially to 7–8+ metres

**Longevity:** long-lived (800+ years)

**Shade:** 4.0

**Drought:** 2.5

**Waterlogging:** 1.0

**Herbivory:** 1.9

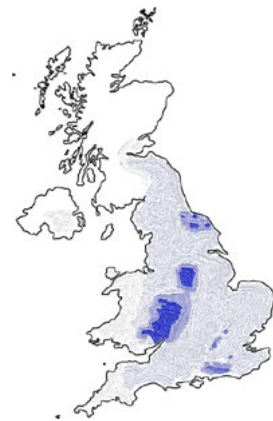
**Fertility:** 3.0

**Supports:** many leaf-feeding insects, including lime hawkmoth and peppered moth, and high insect biomass (e.g. aphids) as prey for other insects and birds and honeydew source. Good summer blossom (**June–July**) for insects. Decaying lime is important for white-rot fungi and invertebrates, similar to, for example, ash, elm and sycamore. Its leaf litter is rapidly returned to the soil by earthworms and other decomposers.

### Design

**Site characteristics:** Quite rare as a tree of ancient semi-natural woods in the UK, and its distinctive and important biogeography should not be eroded. Most appropriate on calcareous soils (**BL**), rarely more acidic soils, but only in key areas around the West Midlands, Peak District, parts of North Yorkshire and the South Downs.

**Structures:** A **minor** component in groves (**gr**) as it is shade tolerant, but many of its functions (e.g. flowering and high insect biomass) might be optimised by some more open grown individuals (**owh/gl**).





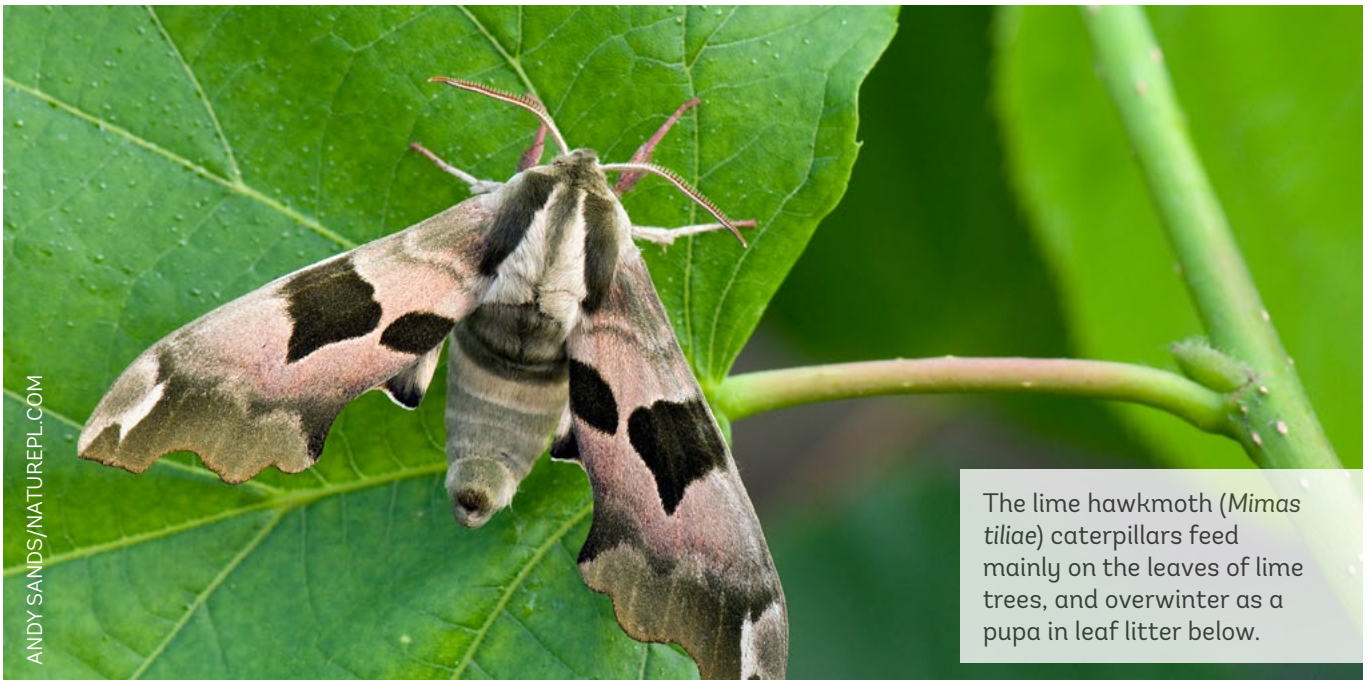
## Initiate

**Dispersal/natural colonisation:** Colonisation from wind-dispersed seed might be expected within 100 metres<sup>14</sup>, but viable seed might be an issue. Limes form ectomycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Where natural colonisation is limited, then planting is likely to be required. Where a project is close to an ancient woodland with large-leaved lime already occurring as a native tree, then it will be most appropriate to consider more local seed collection and propagation. It is very important that planting does not degrade the existing genetic diversity and distinctiveness in native large-leaved lime populations<sup>30</sup>, and their historical context.

## Establish

Highly shade tolerant, and can regenerate and establish in shady groves with other shade-tolerant species like beech. Browsing animals can be an issue to establishment and requires low herbivore impacts. Likely to be relatively resilient to climate-change impacts, and the genetic diversity within the UK's range-edge populations is considered to be significant enough to support an effective response to changing climate<sup>31</sup>.



The lime hawkmoth (*Mimas tiliae*) caterpillars feed mainly on the leaves of lime trees, and overwinter as a pupa in leaf litter below.



BEN LEE/WTML

## Maple, field (*Acer campestre*)

### Ecological characteristics

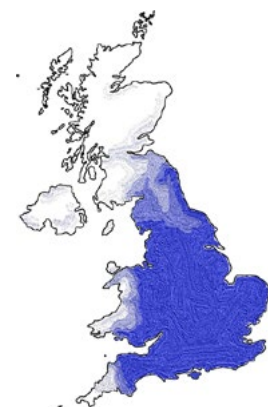
**Status:** deciduous, locally native tree  
**Height:** small to medium-sized (potentially up to 15–20+ metres)  
**Girth:** potentially to 4+ metres.  
**Longevity:** individuals may live to 200+ years  
**Shade:** 3.2  
**Drought:** 2.9  
**Waterlogging:** 1.9  
**Herbivory:** 2.5  
**Fertility:** 3.5

**Supports:** high aphid biomass which in turn feeds insects, birds and species associated with honeydew. Birds and small mammals feed on seed. Flowers can be an important blossom source of food for insects (**May–June**), including numerous mining bees such as broad-margined mining bee. Its nutrient-rich bark can be good for supporting mosses. It shares a lot of leaf-feeding and galling invertebrates and fungi with sycamore.

### Design

**Site characteristics:** Field maple can tolerate and establish in a range of soils and conditions, so long as they are relatively fertile and not too acidic (mainly **BL**). Some heavier calcareous soils are best.

**Structures:** It can establish under fairly shady conditions, so can feature as a **minor** component of denser groves (**gr**), although it will thrive as a **minor** component of open wooded habitats and glades (**owh/gl**) where individuals can best develop larger crowns.





## Initiate

**Dispersal/natural colonisation:** Most regeneration from wind-dispersed seed might be expected within 100 metres<sup>14</sup> where ground conditions are favourable. Maples (all *Acer* species) form arbuscular mycorrhizas, and any associated fungi already occurring in or near a site may support colonisation. Seed production can be erratic, sometimes producing only male flowers after a year of high seed production.

**Direct seeding and/or planting:** Where natural colonisation is unlikely, consider planting using local provenance material, sourced and grown in the UK.

## Establish

It is a relatively fast-growing species, but it will require protection from high herbivore pressures to establish. Although it can establish with some shade, individual trees do need more open conditions to develop into larger-crowned and older individuals. Maintaining field maple in more open wooded habitats and glades will help ensure they perpetuate.



Many spring insects feed on field maple flowers, including the coppice mining bee (*Andrena helvola*) a species of sunny open wooded habitats and glades.

STEVEN FALK





COLIN VARDELL/WTMIL

## Oak, pedunculate (*Quercus robur*)

### Ecological characteristics

**Status:** native, deciduous, broadleaved tree

**Height:** potentially very large (35+ metres)

**Girth:** potentially to 10 metres

**Longevity:** very long-lived (600–1,000+ years)

**Shade:** 2.4

**Drought:** 2.9

**Waterlogging:** 2.0

**Herbivory:** 2.3

**Fertility:** 2.2

**Supports:** rich diversity of decay and mycorrhizal fungi, and lichens on trunks and branches (some that also occur on ash) and lignum. Very important for nature recovery. Over 2,300 species are associated with native oak, and 320 are entirely dependent<sup>36</sup>. Can have very high insect biomass at key times (e.g. the first few weeks after coming into leaf), supporting masses of insect predators, such as birds<sup>1</sup>. Blossom is also important for insects (**April–May**), especially where abundant on large mature trees.

### Design

**Site characteristics:** On a wide range of soils, and can be a **major** component of woods on neutral, heavier and somewhat fertile soils (**BL/AL**). Doesn't thrive on thin soils; for example, over limestone or very infertile, highly acidic soils. Less frequent or **minor** component in upland areas, far west and northwest (**BU**), but hybrids with sessile oak can be frequent.

**Structures:** Consider in all densities, including as part of denser groves (**gr**), in open wooded habitats (**owh**), and as open grown individuals in glades (**gl**) (e.g. with shrubs like hawthorn).



## Initiate

**Dispersal/natural colonisation:** Trees with acorns support most colonisation within 20–30 metres<sup>14</sup>, but some can occur further (e.g. where acorns are moved by birds like jay). Significant mastings approx. every 3–5+ years. Oaks form ectomycorrhizas, and associated fungi (e.g. milkcaps, brittlegills, boletes, etc.) at a site, or producing spores nearby, may support colonisation.

**Direct seeding and/or planting:** Direct seeding can work, with advantages over nursery-grown transplanted trees<sup>29</sup>. For example, lower costs of establishment, and exhibiting reduced drought impacts from natural taproot development. Risk of seed predation by rodents can be reduced by getting acorns into the soil. Where colonisation is unlikely, plant using local provenance material.

## Establish

Slow growing and may require aftercare for a number of years to establish and control competitive vegetation. Herbivore impacts will need to be controlled, although it can be protected; for example, by thorny scrub and brambles. Although it may establish in some younger, denser groves, it is a pioneering tree and will thrive with more light in more open wooded habitats (**owh**). Important to maintain space and light for open growing individuals (**gl**).



MARTIN CREASSER/ALAMY STOCK PHOTO

Acorns are an important food for jays, which in turn support oak dispersal and colonisation.

## Oak, sessile (*Quercus petraea*)

### Ecological characteristics

**Status:** native, deciduous, broadleaved tree

**Height:** potentially very large (35+ metres), but in exposed western locations it can be very twisty and short.

**Girth:** potentially to 7 metres

**Longevity:** very long-lived (600–1,000+ years)

**Shade:** 2.7

**Drought:** 3.0

**Waterlogging:** 1.2

**Herbivory:** 2.3

**Fertility:** 2.1

**Supports:** over 2,300 species which are associated with native oak, 320 of which are entirely dependent<sup>36</sup>.

Very important for nature recovery. Vital for decay and mycorrhizal fungi, and lichens on trunks (including some that also occur on ash), branches and lignum. Can have high insect biomass at key times (e.g. first few weeks after coming into leaf), supporting masses of insect predators such as birds<sup>1</sup>. Good blossom for insects (**April–May**).

### Design

**Site characteristics:** Predominately in the north and west, it can be a **major** component of wooded habitats on relatively infertile neutral to acidic soils (**AU**), and more **minor** elsewhere (e.g. **BU/AL**). Less-well distributed and rarely significant component of woods in English Midlands and East Anglia.

**Structures:** Consider across the range of wooded habitat densities from denser groves (**gr**) to open wooded habitats and glades (**owh/gl**) to ensure some open grown individuals. Hybridises with pedunculate oak.





## Initiate

**Dispersal/natural colonisation:** Although trees with acorns support most colonisation within 20–30 metres<sup>14</sup>, some can occur further (e.g. where acorns are moved by birds like jay). Masting approx. every 3–5+ years. Oaks form ectomycorrhizas, and associated fungi (e.g. milkcaps, brittlegills, boletes, etc.) at a site, or producing spores nearby, may support colonisation.

**Direct seeding and/or planting:** Direct seeding can succeed, with advantages over nursery-grown trees<sup>29</sup>. For example, lower costs of establishment, and reduced impacts from climatic events (e.g. drought) as a result of natural taproot development. Seed predation by rodents can be significant, but risks are reduced by getting acorns into the soil. Where colonisation is unlikely, consider planting using local provenance material.

## Establish

Slow growing and may require aftercare for number of years to establish and control competitive vegetation. Herbivore impacts will need to be controlled, although it can be protected by thorny scrub and brambles. Although it may establish in some younger, denser groves, and is slightly more shade tolerant than pedunculate oak, it is a pioneering tree and thrives in more open wooded habitats (**owh**). Maintain space and light to develop open growing individuals (**gl**).



JONATHAN NEED/WTML

Hundreds of species grow on the trunks and branches of sessile oaks, including lichens, mosses, liverworts and ferns like this Tunbridge filmy fern (*Hymenophyllum tunbrigense*), in sheltered and humid acid upland groves.



TED GREEN/WTML

## Pear, wild (*Pyrus communis sens. lat.*)

### Ecological characteristics

**Status:** deciduous shrubs or small trees. Includes *Pyrus pyrastrer*, and the similar *Pyrus communis* – the latter probably from ancient cultivation – though the two may not be specifically distinct (Stace 2019), but doesn't include Plymouth pear (*Pyrus cordata*) which is only known from Cornwall. Wild pears are possibly native<sup>46</sup>.

**Height:** up to 10+ metres

**Girth:** potentially to 2.5 metres

**Longevity:** potential to live 200+ years

**Shade:** 2.3

**Drought:** 3.2

**Waterlogging:** 1.4

**Herbivory:** 2.5

**Fertility:** 3.5

**Supports:** (as a food plant) 130 species of invertebrate<sup>13</sup>; for example, moths such as green pug and red-belted clearwing, and some unique to *Pyrus*, including micromoth, leaf midge and aphid species. Fruit is fed on by mammals and birds when produced. Good blossom for pollinators, earlier than apple (**April**).

### Design

**Site characteristics:** Tolerates a range of soil conditions and pH, apart from the most acidic, but best with some fertility (e.g. **BL**), and can tolerate dry sites due to its tap roots<sup>56</sup>.

**Structures:** As a fairly small, light-demanding tree, it is best suited to establishing as a relatively **minor** component of open wooded habitats (**owh**), or as individual and more open grown trees in glades (**gl**), where its functions as provider of blossom (nectar, pollen) and fruit will be optimised. It won't thrive in denser groves.



Key to species characteristics = [page 27](#)

## Initiate

### Dispersal/natural colonisation:

Where fruit is produced (which can be very infrequent on some trees and in some areas), it is usually eaten relatively close to the tree, and seed dispersal by birds and small mammals – although possible over some distance – is most likely relatively close (within a few metres) to the parent tree. Pears (all *Pyrus* species) form arbuscular mycorrhizas, and colonisation may be supported by associated species within or near to a site.

**Direct seeding and/or planting:** Its suitability for direct seeding is unknown, but seed collected from mature fruit can be sown immediately<sup>16</sup>. Where wild pear is considered unlikely for a site, consider planting using local provenance material, sourced and grown in the UK.

## Establish

Can be a slow-growing, small tree, and although tolerant of most well-drained soils, it requires good levels of light. Establishing, therefore, requires maintaining more open wooded habitats and sunny glades (**owh/gl**), so as not to be over-topped and shaded by larger and faster-growing trees.



Honey bees feed on wild pear blossom in sunny open wooded habitats and glades.





## Pine, Scots (*Pinus sylvestris*)

### Ecological characteristics

**Status:** coniferous, locally native evergreen tree

**Height:** can be large (35+ metres)

**Girth:** potentially to 4 metres

**Longevity:** long-lived (300+ years)

**Shade:** 1.7

**Drought:** 4.3

**Waterlogging:** 2.9

**Herbivory:** 1.9

**Fertility:** 1.0

**Supports:** over 220 lichens<sup>6</sup> (richest in native, ancient pinewood areas, which are also in the least air-polluted regions), with many specialists depending on older growth and decaying pine. These also fix nitrogen from the air, adding fertility to soil as they fall. Also very important for fungi and wood-decay insects. Wood ants and other insects use honeydew produced by aphids on pine. Pine can support high insect biomass<sup>1</sup>. Insects in bark are food for specialist birds such as crested tit and treecreeper. Seed eaters include chaffinch, siskin, crossbill and red squirrel, while black grouse and capercaillie eat buds and shoots.

### Design

**Site characteristics:** Native pine persists as part of ancient woods in Scotland, and potentially other small, rare refugia. In those regions, a potentially **major** component on free-draining, sandy, infertile and typically acidic soils (**AU**), some waterlogged soils (**WU**), and base-rich rocky sites (**BU**). May be appropriate as a **minor** component in other areas; for example, where well-naturalised and with known pine-associated species.

**Structures:** Thrives in light open wooded habitats (**owh/gl**). Can be in denser young groves (**gr**), but needs space to develop well.



## Initiate

**Dispersal/natural colonisation:** Pioneering species producing large amounts of seed, mostly colonising within 100–200 metres through wind dispersal<sup>14</sup>. Can travel 800 metres, or further if blown over hard snow or ice<sup>5</sup>. Animals (e.g. deer and cattle) also transport seed. Successful colonisation sites are well lit, with some exposed soil or limited competitive plants. Pine forms ectomycorrhizas, and where present, associated fungi (e.g. webcaps, tooth fungi, milkcaps, brittlegills, boletes) may support colonisation. Supporting natural regeneration is the primary objective close to existing native pine sites.

**Direct seeding and/or planting:** Direct seeding is effective. Planting must be in accordance with the pinewood inventory.

## Establish

Establishing pine requires prolonged protection from herbivore impacts, and maintaining good light. Where regeneration has created thickets (including with other species, such as birch), then interventions in the establish phase can give crown for more open grown trees, accelerate growth and provide decaying wood resources – key to many pine specialist species. It is very drought tolerant and likely to be resilient to many climate-change impacts.



The decaying wood of Scots pine supports many specialist lichens and insects, including the pine hoverfly (*Blera fallax*), which, as larvae, uses damp decaying pine wood.

STEVEN FALK





## Poplar, black (*Populus nigra* subsp. *betulifolia*)

### Ecological characteristics

**Status:** broadleaved, native deciduous tree

**Height:** potentially very large (35–40 metres)

**Girth:** potentially to 6–8 metres

**Longevity:** can live 200–300+ years

**Shade:** 2.5

**Drought:** 2.2

**Waterlogging:** 3.7

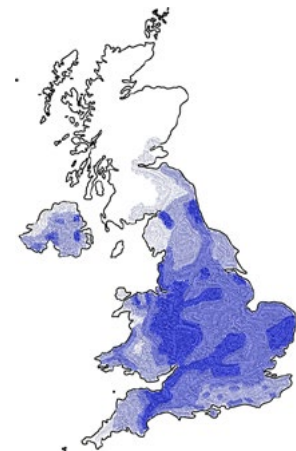
**Herbivory:** 1.5

**Fertility:** 4.0

**Supports:** (as a food plant) many insects, including the impressive hornet moth and poplar hawk moth. The bark may share characteristics with ash (e.g. supporting some similar lichens and mosses). The catkins provide an early source of pollen and nectar for bees and other insects (**April**) which can be a huge resource on large trees.

### Design

**Site characteristics:** Characteristic of many major and smaller rivers, such as catchments of the Severn and Thames and others (e.g. Stour, Parrett). Although well distributed, it is a rare tree, with perhaps as few as 7,000 trees and probably less than 10% female trees able to produce seed. Might be considered as a **major** or **minor** component of seasonally flooded or waterlogged situations by rivers in lowland regions (**WL**). It is best considered alongside wider river restoration projects (e.g. to re-naturalise river channels).



**Structures:** May be represented across a range of structures (**gr/owh/gl**), though will develop best with space in more open wooded habitats and glades.



## Initiate

**Dispersal/natural colonisation:** Natural colonisation of black poplar requires re-naturalising many main river courses, including reconnecting river channels to their floodplains. Tiny, fluffy seed may travel 200 metres or more by wind, but must settle on recent deposits of silt, sand or shingle, free of vegetation, as part of dynamic river systems. This also requires both male and female trees (the latter very rare). Poplars form both ectomycorrhizas and arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding is not advisable. It has recalcitrant seeds (short-lived, highly perishable) and seed can often be hybrid with other poplars. Planting is often necessary, but genetic provenance (from a variety of UK clones), ensuring the sex ratio of trees and future regeneration potential, is required<sup>8</sup>.

## Establish

It is a relatively fast-growing species. Establishment from planted trees will require protecting from herbivory. Longer-term, the species requires dynamic riparian ecosystems with naturalised river channels and floodplains, to provide a supply of new sites for colonisation in dynamic, open wooded habitats and glades (**owh/gl**). Pollarding young trees requires long-term management commitment to cycles of cutting<sup>22</sup>.



The hornet clearwing moth (*Sesia apiformis*) lives for up to three years as a larva in the roots and lower trunk of black poplar trees.



STEVEN FALK

## Privet, wild (*Ligustrum vulgare*)

### Ecological characteristics

**Status:** semi-evergreen or deciduous, broadleaved, locally native shrub

**Height:** small (to 2–3 metres)

**Girth:** typically shrubby

**Longevity:** potentially to 50+ years

**Shade:** 2.3

**Drought:** 3.5

**Waterlogging:** 1.9

**Herbivory:** 2.5

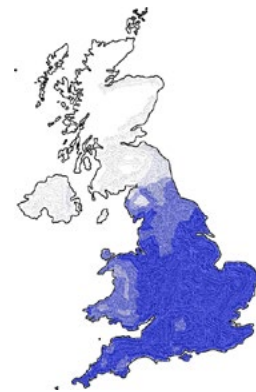
**Fertility:** 2.5

**Supports:** (as a food plant) over 50 insect species<sup>13</sup>, including the privet hawkmoth – one of our largest insects – and the barred tooth-striped moth, a nationally scarce priority species. As the most closely related native tree or shrub to ash (both in family Oleaceae), it can host leaf-feeding associates of ash<sup>28</sup>. Good high summer blossom source (**August**) for pollinators/insects. Berries are eaten by birds such as thrushes, and the shrub can provide important dense cover and nesting sites for small birds.

### Design

**Site characteristics:** Mainly on well-drained, calcareous and base-rich soils (**BL**), particularly in central and southern England and less frequently in the north and parts of Wales.

**Structures:** It can occur as a **minor** component of some lightly shaded groves (**gr**), but prefers more sunny, open wooded habitats and scrubby glades (**owh/gl**), where it can occasionally be a more **major** component. In areas where ash is being lost to dieback, privet may support some leaf-feeding species that could decline.





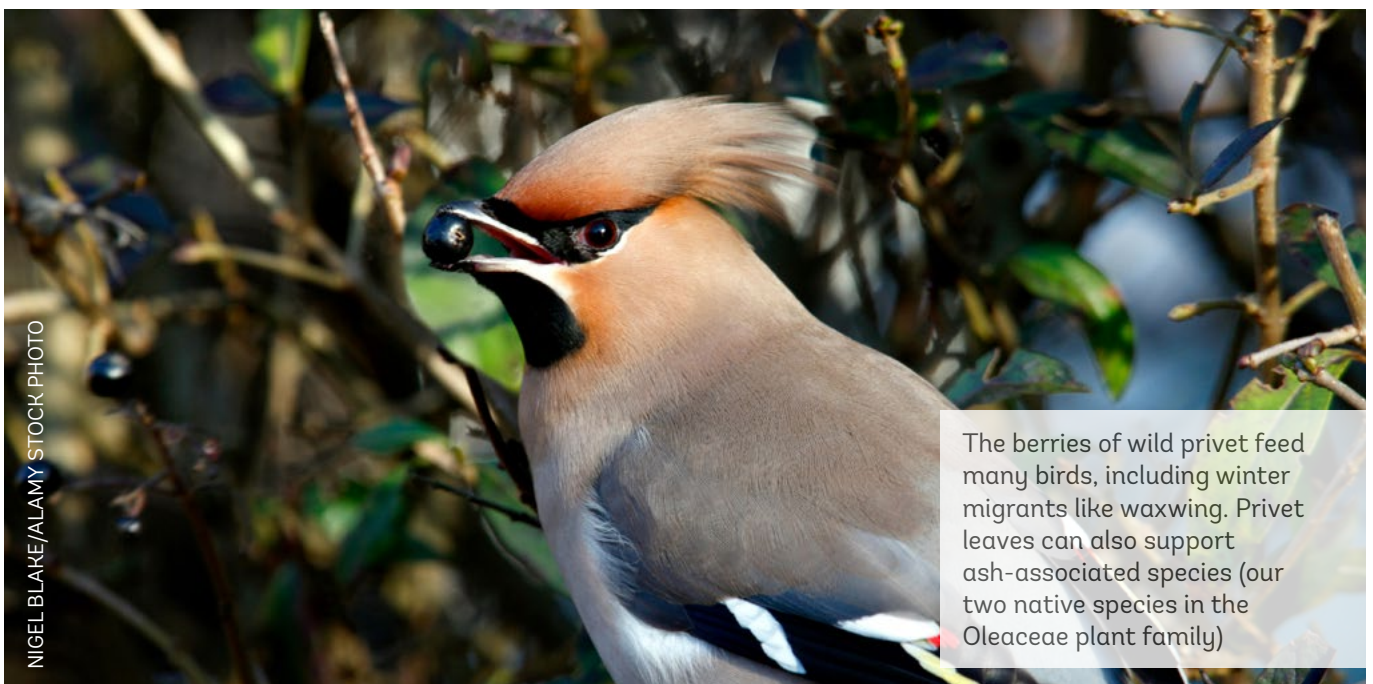
## Initiate

**Dispersal/natural colonisation:** Berries consumed and seed dispersed by birds – mainly thrushes, robin, blackcap<sup>39</sup>. The presence of other fruiting shrubs and perches visited by birds will influence where seed moves. Privet forms arbuscular mycorrhizas, and any associated fungi in or near a site may support colonisation and establishment.

**Direct seeding and/or planting:** Its effectiveness using direct seeding is unknown. Where natural colonisation is unlikely, consider planting using local provenance material, sourced and grown in the UK.

## Establish

Privet is not very quick growing, and establishment of planted trees will require protecting from herbivory. It is relatively more shade tolerant than many other shrubs of base-rich wooded habitats, so could establish as part of groves, or protected by shady thickets of other thorny species (e.g. blackthorn/hawthorn or wild roses and bramble). Once established, privet will both coppice and strongly sucker<sup>39</sup>.



NIGEL BLAKE/ALAMY STOCK PHOTO

The berries of wild privet feed many birds, including winter migrants like waxwing. Privet leaves can also support ash-associated species (our two native species in the Oleaceae plant family)





## Rowan (*Sorbus aucuparia*)

### Ecological characteristics

**Status:** deciduous native tree

**Height:** 15–20 metres

**Girth:** potentially to 3 metres

**Longevity:** individuals can live 200+ years

**Shade:** 2.7

**Drought:** 2.1

**Waterlogging:** 1.8

**Herbivory:** 1.9

**Fertility:** 1.9

**Supports:** at least 50 insect species which feed on its leaves and plant material<sup>13</sup>, such as the autumn green carpet moth and rowan bud weevil. Excellent spring blossom (**May**) for pollinators, particularly flies (hoverflies, blowflies, dagger flies), beetles, and to a lesser extent, bees<sup>47</sup>. Its fruits are highly important for birds in autumn and winter, particularly migratory thrushes, such as redwing and fieldfare, as well as waxwing, starling and residents like mistle thrush, blackbird, bullfinch, tits, robin, pine marten and fox. Smooth acid-bark-associated lichens.

### Design

**Site characteristics:** On a range of soils, moderately moist to moderately dry (a key element of **AU/AL/BU** and to a lesser extent **BL**). Less tolerant of the most waterlogged or heaviest soils.

**Structures:** More shade tolerant during seedling stage, but more light and less crown competition is required as trees mature<sup>47</sup>. Can occur in some younger groves (**gr**), but best as a **major** or **minor** component of open wooded habitats (**owh**) and scattered in glades and open vegetation where it is very tolerant of exposure (**gl**).



## Initiate

**Dispersal/natural colonisation:** A highly pioneering species. Seed spread by birds, such as thrushes, starling, corvids and robin<sup>39</sup>, and pine marten. Bird-dispersed seed may travel long distances (potentially 100 metres, or even much further), and the presence of other fruiting shrubs and perches visited by birds will influence where seed moves. In landscapes with fruiting rowan, consider colonisation where ground conditions are favourable and herbivore pressures relatively low. Rowan forms arbuscular mycorrhizas, and any associated fungi in or near a site may support colonisation and establishment.

**Direct seeding and/or planting:** Can establish well as part of direct seeding; for example, in mixes with small seeded trees like birch and alder<sup>64</sup>. Plant local provenance material where natural colonisation is unlikely and direct seeding is not practicable.

## Establish

Very sensitive to browsing, it requires protection from herbivore impacts for a considerable time to establish. Although it will tolerate a degree of shade as saplings, and can regenerate in some thickets and young groves (e.g. through natural regeneration), it will require more well-lit situations and crown space to develop into larger mature trees. These more open grown trees will also ensure its key ecological functions are optimised, for most prolific flowering and heaviest fruiting.



ROBIN CHITTENDEN/NATUREPL.COM

Rowan berries are a very important seasonal food for many birds, including winter thrushes and resident species like blackbird.

## Spindle (*Euonymus europaeus*)

### Ecological characteristics

**Status:** deciduous, locally native tree or shrub

**Height:** fairly small (to 5–6+ metres)

**Girth:** often much branched, potentially stems to 70+ centimetres

**Longevity:** potentially to 60+ years

**Shade:** 3.0

**Drought:** 3.0

**Waterlogging:** 2.1

**Herbivory:** 3.4

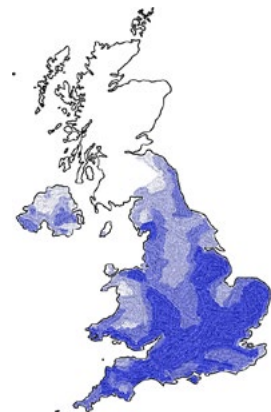
**Fertility:** 3.0

**Supports:** at least 20 species of insect which eat its leaves<sup>13</sup>, including magpie moth and spindle ermine. The seed covering (aril) is very rich in fats and consumed by many birds, including robin, blackbird and blackcap. Flowers are nectar rich and an important food source for hoverflies and other insects (**May–June**). Spindle aphids support predators, including hoverflies, ladybirds and lacewings. Some birds, such as great tit and marsh tit, might move on to spindle fruits (available during autumn and early winter ) after they have finished other fruits, such as elder, bramble, honeysuckle and white bryony<sup>57</sup>.

### Design

**Site characteristics:** Typically on relatively free-draining calcareous soils, such as those overlying limestone or chalk, but also other relatively base-rich geologies (mainly **BL**).

**Structures:** It is fairly shade tolerant and can persist in some denser groves (**gr**), but is often more abundant in more open habitats<sup>57</sup>, and will thrive as a **minor** component of open wooded habitats (owh) with dynamic and transitional glades and open vegetation (**gl**).





## Initiate

**Dispersal/natural colonisation:** Seed dispersed by birds such as robins and thrushes<sup>39</sup>, but seeds are poisonous and the fleshy outer part (aril) is removed from seed, or seed regurgitated, close to or under the bush. So, typically not moving far by seed, although birds may carry up to 20 metres, acting as short-distance dispersers<sup>57</sup>. Spindle is fairly shade tolerant, more so than hawthorn and dogwood, for example, and it can more readily establish under the shade of other pioneer scrub species<sup>57</sup>. It forms arbuscular mycorrhizas, and associated fungi may support colonisation and establishment.

**Direct seeding and/or planting:** Direct seeding may be effective. Where colonisation is unlikely, consider planting local provenance material.

## Establish

Although fairly resistant to grazing by deer and some other animals, it may be vulnerable to rabbits and other smaller mammals<sup>62</sup>, and requires protection from these. Otherwise, there are no serious threats, and spindle is likely to be resilient to many impacts of climate change.



The seed covering is rich in fats and consumed by many birds, including starling, although the seed itself is poisonous and usually discarded close to the bush.



ALASTAIR HOTCHKISS

## Sweet chestnut (*Castanea sativa*)

### Ecological characteristics

**Status:** broadleaved, non-native deciduous tree  
**Height:** potentially large (30+ metres)  
**Girth:** potentially to 10 metres  
**Longevity:** very long-lived (800+ years)

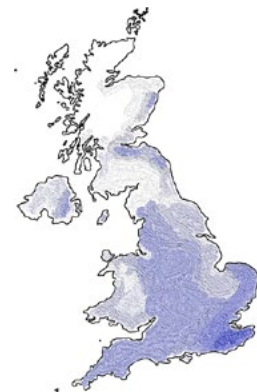
**Shade:** 3.2  
**Drought:** 3.5  
**Waterlogging:** 1.3  
**Herbivory:** 3.5  
**Fertility:** 3.0

**Supports:** micromoths which feed on the leaves and nuts. Summer flowers are used by insects (**July**), while various birds like jay and other animals eat the nuts. Shares some ecological characteristics with native oaks; for example, mycorrhizal and wood-decay fungi, and some associated decay invertebrates. Important for fungi such as hedgehog fungi, but differs from oak in other functions<sup>37</sup>, and shares relatively fewer functions or species associated with ash. Relatively poor for epiphytes and insects associated with leaf feeding and leaf litter.

### Design

**Site characteristics:** Native of southern Europe, most probably introduced around 12th century AD, possibly Roman<sup>20</sup>. Widely planted and naturalised on a range of soils. Thrives on moist, but free-draining soils, in relatively warm areas (e.g. **AL**). Intolerant of waterlogging, very alkaline soils and exposure.

**Structures:** May establish and persist in shadier groves (**gr**). Developing old tree microhabitats (e.g. heart-rot decay similar to oak), best achieved as a **minor** component of open wooded habitats and glades to accelerate development (**owh/gl**).





## Initiate

**Dispersal/natural colonisation:** Most colonisation is expected within about 20–30 metres<sup>14</sup> of a seed-bearing tree. Sweet chestnut forms ectomycorrhizas, and where present, associated fungi may support colonisation and establishment.

**Direct seeding and/or planting:** Its effectiveness using direct seeding is unknown. Where natural colonisation is unlikely, consider planting with material sourced and grown in the UK.

## Establish

Relatively rapid early growth, and generally few significant issues to establishment. Although it may be relatively resilient to some rapid climate-change impacts, chestnut does have a number of tree health issues, and chestnut blight, for example, now occurs in the UK.







NPL/ALAMY

## Sycamore (*Acer pseudoplatanus*)

### Ecological characteristics

**Status:** non-native, broadleaved, deciduous tree  
**Height:** can be large (35+ metres)  
**Girth:** potentially to 7 metres  
**Longevity:** long-lived (400+ years)

**Shade:** 3.7

**Drought:** 2.8

**Waterlogging:** 1.1

**Herbivory:** 3.0

**Fertility:** 3.5

**Supports:** 490 lichen species on its base-rich bark (comparable to ash), including many conservation priorities<sup>7</sup>. Sycamore has an important role now with the loss of ash, with a relatively high number of shared species and functions<sup>35</sup>, including similar decaying wood characteristics. Differs from ash by casting more shade and leaf litter, with implications for ash-associated flora. Excellent blossom (**May–June**) for insects. High aphid biomass for predators and honeydew feeders<sup>1</sup>. Leaf feeders and galls shared with field maple.

### Design

**Site characteristics:** Native of mainland Europe, but well naturalised and distributed on a wide range of soils (mainly **BL/BU**), avoiding the most acidic, infertile or waterlogged soils.

**Structures:** Sycamore might be included where it is already present in a landscape as a **minor** component of groves (**gr**), and in open wooded habitats and glades (**owh/gl**), where many of its functions (e.g. shared characteristics with ash) can be optimised by more well-lit trees, and where it can accelerate provision of decay microhabitats of larger trees.



## Initiate

**Dispersal/natural colonisation:** Most colonisation is expected within 100 metres of seed-producing trees<sup>14</sup>. Can be self-compatible, and has a short generation time (15–30 years) with regular production of wind-dispersed seeds. All acer species form arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Where colonisation is unlikely, direct seeding can be effective, but vulnerable to seed predation, and vegetation conditions must be favourable to seedling survival and growth<sup>21</sup>. Caution with planting in some areas, mainly where it is not currently a significant feature, particularly adjacent or close to some ancient woodland sites where not already a component.

## Establish

Establishing sycamore requires protecting from high herbivore impacts. It can suffer from grey squirrel damage (e.g. young dense groves). Its comparable wood decay and bark habitats to ash are likely to be optimised by developing trees with limited crown competition in more structures. Can dominate and outcompete other species in dense groves<sup>63</sup>. Relatively resilient to climate change, and severe droughts may reduce its competitiveness<sup>38</sup>.



Lichens on sycamore including tree lungwort (*Lobaria pulmonaria*). Well-lit sycamore in open wooded habitats and glades can support rich communities of lichens, many shared with ash.





## Wayfaring tree (*Viburnum lantana*)

### Ecological characteristics

**Status:** locally native shrub  
**Height:** small (to 4–5 metres)  
**Girth:** typically much-branched  
**Longevity:** potentially to 50+ years

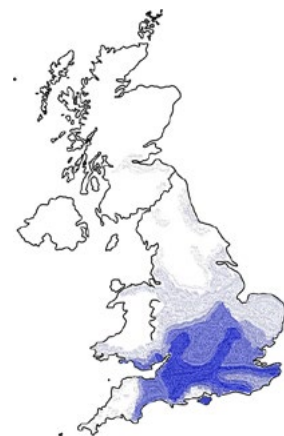
**Shade:** 1.9  
**Drought:** 3.5  
**Waterlogging:** 1.7  
**Herbivory:** 4.0  
**Fertility:** 2.5

**Supports:** over 30 insect species which specialise by feeding on the wayfaring tree, including the impressive orange-tailed clearwing moth which spends two years as larvae in the stems. The early spring flowers (**May**) provide for beetles and bees, including the tawny mining bee<sup>26</sup>. The drupe is consumed from mid-summer by birds and small mammals, but is less favoured than other fruits, and feeding declines as preferred fruits become available (**Sept–Oct**)<sup>26</sup>. Thus, many fruits dry up on the shrub, sometimes fed on in winter by birds such as bullfinch.

### Design

**Site characteristics:** Particularly characteristic as a native of wooded habitats on free-draining soils over chalk and limestone in southern England (**BL**). Occasionally on base-rich clays that are liable to severe drying in summer, but mainly very moist. Absent from waterlogged soils.

**Structures:** Appropriate mainly in and around its core areas in the southern half of England, in well-lit, open-wooded habitats and glades (**owh/gl**), its name originating from it often being found on or near paths. Will not tolerate shadier groves.





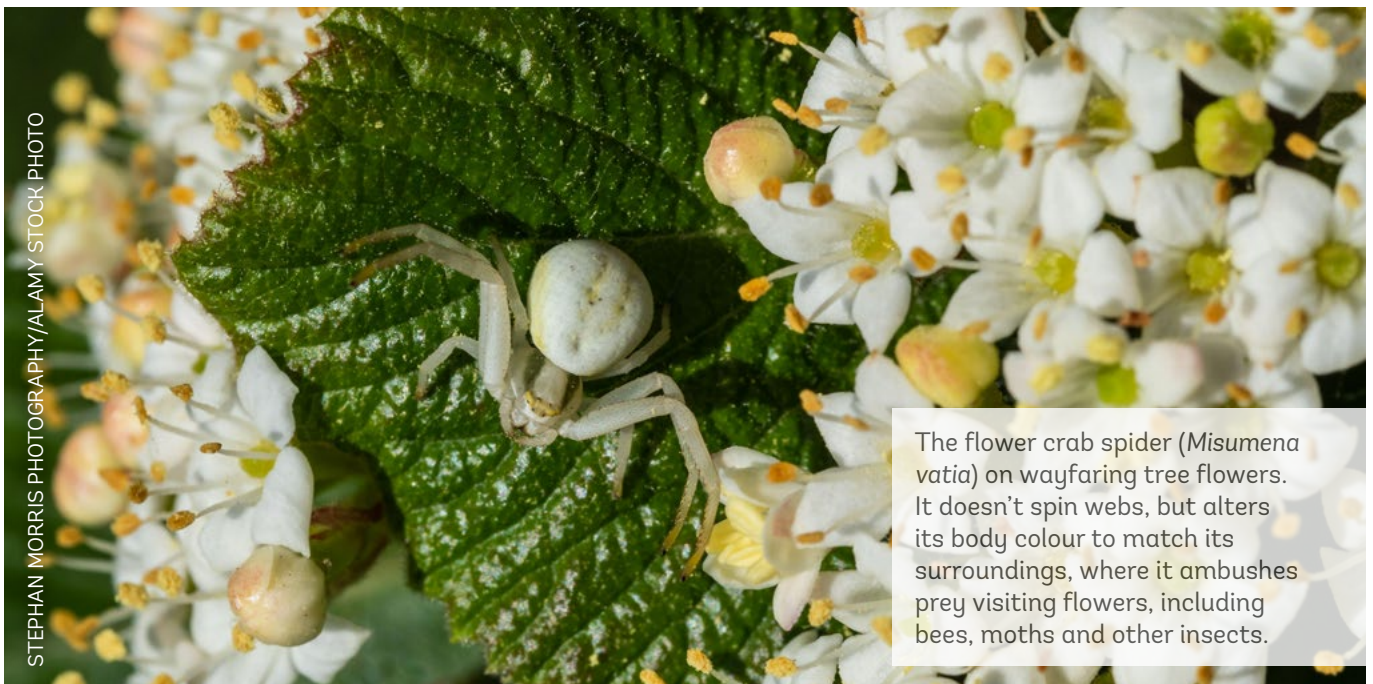
## Initiate

**Dispersal/natural colonisation:** Drupe consumed and seed spread by birds – mainly thrushes, robin and warblers<sup>39</sup>. Because the fruits are somewhat less favoured than those of other shrubs (such as elder), its seeds are widely dispersed, but mainly to beneath other shrubs<sup>25</sup>. *Viburnum* species form arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation. It can also spread vegetatively.

**Direct seeding and/or planting:** Its effectiveness using direct seeding is unknown, so where natural colonisation is unlikely, consider planting in appropriate areas using local provenance material, sourced and grown in the UK.

## Establish

It is considered to be highly unpalatable to deer and rabbits<sup>26</sup> and could be established in areas with some herbivore presence. This may also help to ensure that there is sufficient light for it to establish. It will not tolerate shade in denser groves, so longer-term persistence and regeneration requires dynamic, open wooded habitats and glades (**owh/gl**).



The flower crab spider (*Misumena vatia*) on wayfaring tree flowers. It doesn't spin webs, but alters its body colour to match its surroundings, where it ambushes prey visiting flowers, including bees, moths and other insects.

STEPHAN MORRIS PHOTOGRAPHY/JALAMY STOCK PHOTO



## Whitebeam, common (*Sorbus aria sens. str.*)

### Ecological characteristics

**Status:** a fairly compact, deciduous, locally native broadleaved tree  
**Height:** small-medium (to 15+ metres)  
**Girth:** potentially to 2.5+ metres  
**Longevity:** potentially to 150+ years

**Shade:** 3.0

**Drought:** 3.6

**Waterlogging:** 1.3

**Herbivory:** 2.2

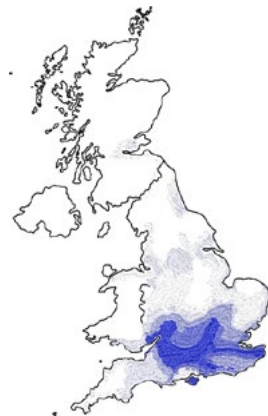
**Fertility:** 2.1

**Supports:** over 160 known insect species which feed on the genus *Sorbus* in the UK<sup>39</sup>, although this also includes rowan and wild service tree, for example. Its ripe fruit in late summer to autumn is fed on by many birds. Good spring (**May**) blossom source for insects. The leaves are also eaten by many more insects.

### Design

**Site characteristics:** There are many native whitebeam species occurring in parts of the UK, often very locally and rare (see page 128 for species not included). Common whitebeam can be a part of woods in southern regions, particularly over very base-rich (**BL**) soils (e.g. over chalks and limestone), with yew, for example.

**Structures:** It has been planted outside these areas, often as individual trees, but most appropriate for woodland creation close to its locally native range as a **minor** component of groves (**gr**) and open wooded habitats (**owh**).



## Initiate

**Dispersal/natural colonisation:** Fruit consumed and seed dispersed by birds, particularly thrushes, starling and corvids<sup>39</sup>. *Sorbus* species all form arbuscular mycorrhizas, and any associated fungi in or near a site may support colonisation and establishment.

**Direct seeding and/or planting:** Its effectiveness using direct seeding is unknown. Where natural colonisation is unlikely, consider planting in appropriate areas using local provenance material, sourced and grown in the UK.

## Establish

Establishment will require protecting from high herbivore impacts and competitive vegetation. Although it may tolerate and persist with some shade in denser groves, it is likely to require more dynamic, open wooded habitats and glades to persist and thrive. Likely to be relatively resilient to climate change, and fairly tolerant of regular drought events.





## Wild service tree (*Sorbus torminalis*)

### Ecological characteristics

**Status:** deciduous, locally native broadleaved tree

**Height:** potential to reach 20–25 metres

**Girth:** potentially to 3 metres

**Longevity:** can live 200+ years

**Shade:** 3.4

**Drought:** 3.7

**Waterlogging:** 1.0

**Herbivory:** 2.1

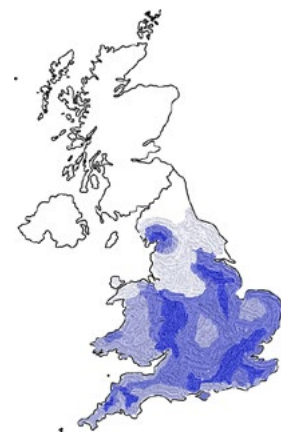
**Fertility:** 2.5

**Supports:** at least 40 insect species known to feed specifically on wild service leaves and plant material, with some restricted to it (e.g. micromoth *Stigmella torminalis*). Many more species visit its flowers for pollen and nectar (**May–June**). Over 40 known species of fungi and slime mould are also associated with the tree, its wood and leaf litter<sup>61</sup>, while its fruits are fed on by birds, including thrushes, bullfinch, robin and marsh tit.

### Design

**Site characteristics:** Distinctive biogeography, with native populations in core ancient wooded landscapes (southeast England, The Weald, Welsh Marches, New Forest, south Cumbria). A wide variety of soils, often clayey, on base-rich geologies (**BL**), but some neutral and acidic.

**Structures:** Consider in and around core areas, as a typically **minor** component across all densities, but particularly in open wooded habitats (**owh**). Respecting the native range of wild service tree helps protect genetic integrity and historical context.



## Initiate

**Dispersal/natural colonisation:** Fruit consumed and seed dispersed by birds, potentially far, but viable seed can be limited to very warm years. Less-effective dispersal by birds compared to rowan and hawthorn: most of its dull brown fruits often remain and fall from the tree<sup>61</sup>. *Sorbus* species all form arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation. It shares some mycorrhizal fungi with plants of more open vegetation, such as red clover<sup>61</sup>. Spreads by suckering/root layering within 15 metres of parents, occasionally 30 metres, exceptionally 100 metres<sup>61</sup>. Its distinct biogeography and association with ancient woodlands is important<sup>50</sup>.

**Direct seeding and/or planting:** Woodland creation close to known native wild service tree populations must always support local translocations wherever possible.

## Establish

Saplings readily browsed and may need protecting. Can bear some shade for a time, as suckers and seedlings, but relies on more open and well-lit situations for mature trees to develop. Readily out-competed, so usually only reaches maximum height in open wooded habitats where light fluxes are high<sup>63</sup> or where conditions reduce other trees' dominance. Few known threats, and likely to be relatively resilient to climate-change impacts, particularly droughts. Can respond well to coppicing.



NIGEL CATTLIN /ALAMY STOCK PHOTO

Wasp longhorn beetle (*Clytus arietis*) larvae live in the decaying wood of native broadleaved trees, including wild service tree. Like many wood-decay insects, it requires flowers for food as adults.





## Willow, bay (*Salix pentandra*)

### Ecological characteristics

**Status:** deciduous, locally native shrub or small tree

**Height:** 10–15 metres

**Girth:** potentially to 1+ metres

**Longevity:** potentially to 100+ years

**Shade:** 1.9

**Drought:** 0.5

**Waterlogging:** 4.0

**Herbivory:** 2.1

**Fertility:** 2.1

**Supports:** (collectively across all willows, *Salix* spp.) at least 750 insect species, with over 200 that depend entirely on willows<sup>39</sup>. Willows can freely hybridise; for example, bay willow x crack willow hybrids occur. Bay willow can be an important substrate for many bryophytes<sup>18</sup>. Willows also support distinctive fungi, including decay and ectomycorrhizal species (e.g. webcaps, knights and poisonpies). Bay willow is an important blossom source for pollinators/insects, and catkins appear with or after the leaves (**May–June**).

### Design

**Site characteristics:** A species of damp, wet soils, though not very fertile (mainly **WU**). Mostly in northern regions, from mid-Wales/Cheshire to hotspots in Scottish border regions, central and eastern Scotland, and locally frequent in Northern Ireland. A **minor** or less commonly **major** component on regularly waterlogged or poorly aerated soils, including by small watercourses.

**Structures:** Thrives with light in open wooded habitats and marshy glades (**owh/gl**), or in some groves with other willows and not more competitive larger trees.





## Initiate

**Dispersal/natural colonisation:** Most colonisation from wind-dispersed seed is expected within 200 metres of seed-producing trees, but requires exposed moist soils for seedlings to establish. Willows form both ectomycorrhizas and arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding of bay willow is probably not an option, unless very locally translocated and well timed. It has highly recalcitrant seeds (short-lived, highly perishable with problematic storage). Where natural colonisation is unlikely, consider planting in appropriate parts of the UK, although currently, local provenance zone supply may be difficult for bay willow. Local propagation projects might be considered, including from cuttings.

## Establish

Likely to require protecting from herbivore impacts while establishing, and also maintaining light conditions. As a species that is highly intolerant of drought, this may be an issue to establishing and future climatic change, although site selection should ensure appropriate locations with regularly high water table.



LARS SKIPPER

The bay willow plant bug (*Orthotylus virens*) feeds and lives on willows; almost exclusively bay willow.



## Willow, crack (*Salix fragilis*)

### Ecological characteristics

**Status:** deciduous tree; native status uncertain<sup>32</sup>, but most likely an ancient introduction

**Height:** potentially large (25+ metres)

**Girth:** potentially to 5 metres

**Longevity:** can live for 200+ years

**Shade:** 1.4

**Drought:** 1.2

**Waterlogging:** 3.9

**Herbivory:** 2.5

**Fertility:** 4.0

**Supports:** (collectively with other willows, *Salix* spp.) at least 750 insect species, with over 200 that depend entirely on willows<sup>39</sup>. Well distributed on damp or seasonally flooded fertile soils beside watercourses and waterbodies. On damper soils, it may provide some functions shared by ash, such as fissured, nutrient-rich bark on older trees, and similar decay characteristics. Supports mosses and liverworts that specialise on riverside and seasonally flooded trees. Flowers (**April**) are an important source for pollinators.

### Design

**Site characteristics:** Typically on seasonally flooded or permanently damp sites (e.g. particularly by lowland watercourses, fertile floodplains) in some parts of lowland UK (mainly **WL**). Requiring relatively high fertility and periodically or permanently high water table.

**Structures:** Consider as a typically **minor** component of riparian wooded habitats, including groves, open wooded habitats and glades (**gr/owh/gl**).





## Initiate

**Dispersal/natural colonisation:** Most colonisation from wind-dispersed seed might be expected within 200 metres of seed-producing trees, with some potentially further. Willows form both ectomycorrhizas and arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding of crack willow is probably not an option. It has highly recalcitrant seeds (short-lived, highly perishable with problematic storage). Like most willows, it can be established easily from cuttings. Where natural colonisation is unlikely, then consider planting in appropriate parts of the UK, either from cuttings or from local provenance zone nursery-supplied trees.

## Establish

Likely to require protecting from herbivore impacts while establishing, and also maintaining light conditions. As a species that is intolerant of drought, this may be an issue to establishing and climate change. Site selection should have ensured appropriate locations with regularly high water table.



ALASTAIR HOTCHKISS

Riverside crack willows support specialist mosses that tolerate being seasonally flooded and silt-covered, including water screw-moss (*Syntrichia latifolia*) and many-fruited *Leskea* (*Leskea polycarpa*).





## Willow, eared (*Salix aurita*)

### Ecological characteristics

**Status:** native shrub

**Height:** typically no more than 2–3 metres

**Girth:** typically shrubby and much-branched

**Longevity:** potentially to 50+ years

**Shade:** 1.9

**Drought:** 0.5

**Waterlogging:** 4.3

**Herbivory:** 3.0

**Fertility:** 1.5

**Supports:** (collectively across all willows, *Salix* spp.) at least 750 insect species, with over 200 that depend entirely on willows<sup>39</sup>. Occurring in damp or wet acidic and very infertile sites, and an important component of scrubby and open wooded habitats in the uplands (but not exclusively an upland species). Freely hybridises with a number of other willows; for example, with grey willow. Eared willow blossom appears before leaves (**April–May**) and can be a highly important source of nectar and pollen for pollinators/insects.

### Design

**Site characteristics:** Appropriate in damp, wet, marshy, and infertile soils, typically more acidic (mainly **WU**, less so **WL**), and some freer-draining, sandy, acid soils with high rainfall (**AU**). It can be one of the most abundant willows in parts of Scotland and is frequent in upland parts of England and Wales, for example.

**Structures:** Consider as a typically **minor**, or in some areas a **major** component (more so than grey willow) of open wooded habitats and damp glades (**owh/gl**). Tolerant of exposure and potentially up to high altitudes (at least 900 metres).



## Initiate

**Dispersal/natural colonisation:** Pioneering species. Most colonisation from wind-dispersed seed might be expected within 200 metres of seed-producing trees, some potentially further. Willows form both ectomycorrhizas and arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding of eared willow is probably not an option, unless very locally translocated and well timed. It has short-lived, highly perishable seeds, with problematic storage. Planting eared willow setts (stem cuttings) can be successful, especially in spring just before bud burst, and planted on the same day as being cut. Any planting of eared willow must be of UK sourced and grown nursery stock from local provenance.

## Establish

May be able to establish with some herbivore pressures (more so than some other willow species), although not where persistently high. Site selection should have ensured appropriate locations with regularly high water table.







## Willow, dark-leaved (*Salix myrsinifolia*)

### Ecological characteristics

**Status:** small, locally native deciduous tree of damp sites

**Height:** 3–4 metres, sometimes lower and sprawling

**Girth:** variable shrub or bushy form or small tree, potentially to 1 metre

**Longevity:** potentially to 100 years

**Shade:** 2.3

**Drought:** 1.0

**Waterlogging:** 4.0

**Herbivory:** 2.1

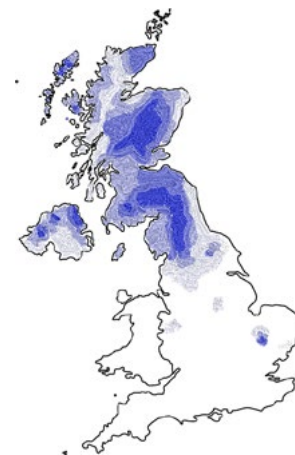
**Fertility:** 2.1

**Supports:** (collectively across all willows, *Salix* spp.), at least 750 insect species, with over 200 that depend entirely on willows<sup>39</sup>. Willows can be an important substrate for many bryophytes<sup>18</sup>. They also support distinctive fungi, including decay and ectomycorrhizal species (e.g. webcaps, knights, poisonpies). Dark-leaved willow catkins appear with the leaves (**April–May**) and are an important blossom source for pollinators/insects.

### Design

**Site characteristics:** In wooded habitats on damp, rocky and fairly infertile and fertile soils, river banks and lakeside gravels. Avoids the most acidic ground. Sometimes on marshy ground by wet woodland margins and dune slacks. A rather local and typically **minor** component of wooded habitats in upland Northern England, Scotland and Northern Ireland (**WU**), and very localised in parts of East Anglian fens.

**Structures:** Best considered in more scattered open-wooded habitats, glades and some groves (**owh/gl/gr**).





## Initiate

**Dispersal/natural colonisation:** Where ground conditions are favourable, most colonisation from wind-dispersed seed might be reasonably expected within 200 metres of seed-producing trees. Willows form both ectomycorrhizas and arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding of dark-leaved willow is problematic (highly short-lived, perishable seed). But, like most willows, cuttings are likely to be successful. Where natural colonisation is unlikely, then consider local propagation projects or planting with material sourced and grown in the UK, although currently, local provenance zone supply may be difficult for dark-leaved willow.

## Establish

Likely to require protecting from herbivore impacts while establishing, and also maintaining light conditions. Site selection should have ensured appropriate locations with regularly high water table, so drought is not an issue to establishment. Slightly more tolerant of shade than many other willows, it could establish as part of some younger groves, but may require management to maintain the species longer term, or in mosaics with more dynamic open wooded habitats.



ROBERT THOMPSON/NATUREPL.COM

The caterpillar of the puss moth (*Cerura vinula*) feeds on various willows (*Salix* spp.), aspen and poplar (*Populus* spp.).



## Willow, goat (*Salix caprea*)

### Ecological characteristics

**Status:** small, native deciduous tree  
**Height:** small (to 15+ metres)  
**Girth:** potentially to 3+ metres  
**Longevity:** short-lived (to around 100+ years)

**Shade:** 2.2  
**Drought:** 2.2  
**Waterlogging:** 2.8  
**Herbivory:** 2.1  
**Fertility:** 3.8

**Supports:** (collectively across all willows, *Salix* spp.) at least 750 insect species, with over 200 that depend entirely on willows<sup>39</sup>. Highly important for insect biodiversity. Goat willow is the foodplant of the purple emperor butterfly and the striking caterpillars of puss moth. Very important early (**Jan–Mar**) blossom source for pollinators, including bumblebee queens and mining bees (e.g. *Andrena clarkella*, *A. praecox*)<sup>12</sup>, and even blue tits feeding on nectar<sup>10</sup>. Nutritious leaves as food for browsing herbivorous animals. An important substrate for many lichens, mosses and liverworts<sup>18</sup>.

### Design

**Site characteristics:** A species of wooded habitats across the UK, and tolerating somewhat drier (not frequently waterlogged or saturated soils) and more base-rich soils than grey willow and many other willows. On a range of soils (including **BU, BL, AU, AL**), goat willow might be a **minor** or potentially **major** component.

**Structures:** It might establish as part of younger groves (**gr**), and can persist with some shade, but will thrive more in open wooded habitats and glades (**owh/gl**).



## Initiate

**Dispersal/natural colonisation:** Most colonisation from wind-dispersed seed might be expected within 200 metres of seeding trees<sup>14</sup>, but some travel much further. Willows form both ectomycorrhizas and arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding of goat willow is problematic, unless well-timed and quickly translocated. Seed may also be a hybrid with a number of other willows in an area; for example, with grey willow and osier. Can flower and seed at a young age (2–3 years onwards), so a few individuals soon support wider colonisation. Unlike other willows, it is less successfully propagated by cuttings<sup>10</sup>. Plant only local-provenance material, UK sourced and grown.

## Establish

Fast-growing species, but will require a degree of protection from high herbivore pressures to establish. Although it may establish in some denser young groves, ultimately it will need space and light to perpetuate as it requires dynamic open wooded habitats and glades. There are currently<sup>10</sup> no severe threatening diseases or significant issues and it is likely to be relatively resilient to climate-change impacts.



The caterpillars of the purple emperor butterfly (*Apatura iris*) feed on goat willow. As adults, they feed mainly on aphid honeydew and sap in the canopy of trees like oak.





## Willow, grey (*Salix cinerea*)

### Ecological characteristics

**Status:** small, native deciduous tree

**Height:** to around 10+ metres

**Girth:** potentially to 1.5+ metres

**Longevity:** relatively short-lived (to around 100+ years)

**Shade:** 1.9

**Drought:** 0.1

**Waterlogging:** 4.1

**Herbivory:** 2.5

**Fertility:** 2.5

**Supports:** (collectively across all willows, *Salix* spp.) at least 750 insect species, with over 200 that depend entirely on willows<sup>39</sup>. Grey willow is a larval foodplant for many moths, including sawfly kitten, sawfly clearwing and the purple emperor butterfly. A very important early (**Mar–Apr**) blossom for pollinators; for example, bumblebee queens and solitary mining (*Andrena*) bees<sup>12</sup>. It can be an important substrate for many mosses, liverworts and lichens<sup>18</sup>. Bark of willows is the favoured winter food of European beaver.

### Design

**Site characteristics:** Two distinct subspecies with rusty grey willow (*Salix cinerea* subsp. *oleifolia*, syn. *Salix atrocinnerea*), the most widespread across the UK, and true grey willow (*Salix cinerea* subsp. *cinerea*), characteristic mainly of East Anglia and Lincolnshire<sup>32</sup>. Can be a **major** component of a range of wooded habitats on very wet and waterlogged soils (particularly **WU** and **WL**). More **minor** component of damper soils (or high rainfall) in otherwise drier woods (e.g. **AU/AL/BU/BL**).

**Structures:** Across all densities (**gr/owh/gl**), but persistence in groves may be determined by how wet and waterlogged sites are as will be outcompeted by taller trees of drier habitats (alder, oak, etc.). Will develop best with light in open wooded habitats and glades.



## Initiate

**Dispersal/natural colonisation:** A highly pioneering species, most colonisation from wind-dispersed seed expected within 200 metres of seed-producing trees<sup>14</sup>, but some much further. Willows form both ectomycorrhizas and arbuscular mycorrhizas, and associated fungi may support colonisation where present.

**Direct seeding and/or planting:** Direct seeding is problematic, with short-lived, highly perishable seed. However, it can begin flowering and seed production at a young age (2–3 years onwards), so a few individuals soon support wider colonisation. Like most willows, cuttings are likely to be successful. Where natural colonisation is unlikely, then consider planting with local provenance material, sourced and grown in the UK.

## Establish

Hybridises freely with other willows (including goat willow, eared willow and others), and there can be much introgression with other species in some areas. It is highly intolerant of drought, although site selection should ensure this is not an issue to establishment. Thrives in dynamic, damp, open wooded habitats and glades, but can establish and dominate some denser wooded groves on the wettest ground. It may be outcompeted and shaded where other taller trees can establish.



Grey willow blossom is an important early spring source of food for many insects, such as the bumblebee-mimicking hoverfly *Eristalis intricarius*.



## Willow, osier (*Salix viminalis*)

### Ecological characteristics

**Status:** shrub, native status uncertain (most probably an ancient introduction, less likely native than purple willow)

**Height:** potentially to 3–6 metres

**Girth:** typically multi-stemmed

**Longevity:** probably relatively short-lived (to 100 years)

**Shade:** 1.9

**Drought:** 0.5

**Waterlogging:** 3.9

**Herbivory:** 3.0

**Fertility:** 3.5

**Supports:** (collectively across all willows, *Salix* spp.) at least 750 insect species, with over 200 that depend entirely on willows<sup>39</sup>, including the herald and red-tipped clearwing moths. Catkins provide important early (**April–May**) nectar and pollen for bees and other insects. Almond willow (*Salix triandra*) is similar in appearance and characteristics, also likely introduced for basket industries, but more localised in England and south Wales; for example, in Somerset, Norfolk and lower river Severn, Trent and Towy. The two freely hybridise (e.g. *Salix triandra* x *Salix viminalis*).

### Design

**Site characteristics:** Might be considered as a typically **minor** component of some seasonally flooded or permanently damp sites (e.g. by watercourses, floodplains) in some parts of lowland UK (**WL**).

**Structures:** Requiring more open wooded habitats and marshy glades (**owh/gl**).





## Initiate

**Dispersal/natural colonisation:** Pioneering species, with colonisation from wind-dispersed seed expected within 200 metres of seeding trees<sup>14</sup>, where ground conditions are favourable. Seeding from young age, so a few individuals soon support wider colonisation. Stem fragments may also move on water and establish downstream. Willows form ectomycorrhizas and arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding of *S. viminalis* or *S. triandra* is not practicable, with short-lived, highly perishable seed. Cuttings (setts) readily take root, establishing new individuals at high densities. Plant only UK sourced and grown material, from appropriate provenance zones.

## Establish

Likely to require protecting from herbivore impacts while establishing, and also maintaining light conditions. But otherwise, a very fast-growing species, characteristically responding vigorously after being cut.





ALASTAIR HITCHKISS

## Willow, purple (*Salix purpurea*)

### Ecological characteristics

**Status:** native shrub or small tree.

**Height:** variable habit, sometimes low and spreading (rarely more than 1.5 metres) and occasionally a small tree up to around 5 metres.

**Girth:** typically multi-stemmed with relatively thin shoots

**Longevity:** relatively short-lived (to 100 years)

**Shade:** 1.2

**Drought:** 1.4

**Waterlogging:** 3.6

**Herbivory:** 3.0

**Fertility:** 3.0

**Supports:** (collectively across all willows, *Salix* spp.) at least 750 insect species, with over 200 that depend entirely on willows<sup>39</sup>, and at least 60 known specifically from purple willow<sup>13</sup>, including 13 gall midges, numerous true bugs and sawflies. Willows are a highly important blossom source for pollinators/insects, and purple willow catkins appear before the leaves (**March–May**).

### Design

**Site characteristics:** Its natural habitats include river margins and gravel banks by watercourses and in lowland floodplains (e.g. **WL**) where deep tap roots enable them to anchor themselves against seasonal high-energy flows/floods<sup>27</sup>. Can also occur on some damp hillsides in upland regions (**WU**), but not montane.

**Structures:** Consider as a typically **minor** component of some dynamic open wooded habitats and glades (**owh/gl**) on seasonally flooded or permanently damp sites.



## Initiate

**Dispersal/natural colonisation:** Pioneering species. Colonisation from wind-dispersed seed might be expected within 200 metres of seeding shrubs, if the right soil conditions are present. More likely, distribution is through water transport, which can also carry bits of plant material able to take root. Willows form both ectomycorrhizas and arbuscular mycorrhizas, and associated fungi may support colonisation.

**Direct seeding and/or planting:** Direct seeding of purple willow is impractical, unless very well-timed. It has highly recalcitrant seeds (short-lived, highly perishable with problematic storage). Cuttings (setts) can be easily established, and any planting should be of local provenance material, sourced and grown in the UK.

## Establish

Fast growing, but likely to require protecting from herbivore impacts while establishing, and also maintaining light conditions. In riparian sites, as with black poplar, purple willow requires dynamic river ecosystems where naturalised channels, gravels and floodplains provide a supply of new sites for colonisation<sup>27</sup>.







## Willow, tea-leaved (*Salix phylicifolia*)

### Ecological characteristics

**Status:** shrub or small, locally native tree

**Height:** typically, little more than 3 metres

**Girth:** typically, much-branched

**Longevity:** probably relatively short-lived (to 100 years)

**Shade:** 1.9

**Drought:** 0.5

**Waterlogging:** 4.3

**Herbivory:** 2.1

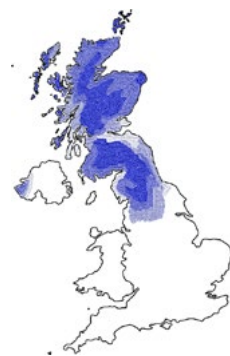
**Fertility:** 1.9

**Supports:** (collectively across all willows, *Salix* spp.) at least 750 insect species, with over 200 that depend entirely on willows<sup>39</sup>. Willows can be an important substrate for many mosses and liverworts<sup>18</sup>. Scrubby, open woodland habitats – with willows such as tea-leaved willow – are likely to support nesting and roosting birds and other animals using shelter in otherwise exposed locations. Willows are a highly important blossom source for pollinators/insects, and tea-leaved willow catkins appear with the leaves (April–May).

### Design

**Site characteristics:** A northern species of wooded habitats on moist, fairly infertile, and sometimes rocky ground and the margins of waterbodies – most often on calcareous geologies (e.g. limestones) in Northern England, Scotland and Northern Ireland (**WU**), avoiding the most acidic ground.

**Structures:** Consider as a typically **minor** component of open wooded habitats and glades (**owh/gl**).



## Initiate

**Dispersal/natural colonisation:** Colonisation from wind-dispersed seed might be expected within 200 metres of seed-producing trees, if the right soil conditions are present. Plant material also carried through water, where fragments of stem can take root. Willows form ectomycorrhizas and arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding is not practicable, with short-lived, highly perishable seed. Where colonisation is unlikely, planting setts (stem cuttings from local populations) before bud burst in spring can be successful. Nursery-grown material must be sourced and grown in the UK, but currently, local provenance zone supply may be difficult for tea-leaved willow.

## Establish

Likely to require protecting from herbivore impacts while establishing, and also maintaining light conditions. As a species that is highly intolerant of drought, this may be an issue to establishing, but site selection should ensure appropriate locations with high water table.



DAVID WHITAKER/ALAMY STOCK PHOTO

The heath bumblebee (*Bombus jonellus*) feeding on tea-leaved willow catkin.



## Willow, white (*Salix alba*)

### Ecological characteristics

**Status:** deciduous tree of damp, fertile habitats; possibly a native of the British Isles<sup>3,32</sup>, or an ancient introduction from mainland Europe, where it is a tree of natural riverside and floodplain woodland habitats<sup>27</sup>

**Height:** potentially large tree (to 30+ metres)

**Girth:** potentially to 8 metres

**Longevity:** individuals can live for 200+ years

**Shade:** 1.9

**Drought:** 1.9

**Waterlogging:** 4.1

**Herbivory:** 2.1

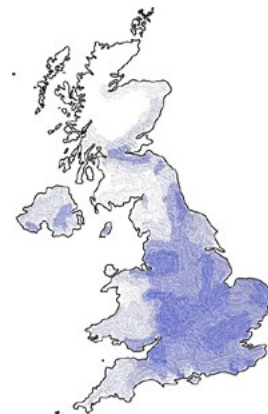
**Fertility:** 4.5

**Supports:** (collectively across all willows, *Salix* spp.) at least 750 insect species, with over 200 that depend entirely on willows<sup>39</sup>. White willow can be a highly important blossom source for pollinators/insects, and catkins appear with the leaves (**April–May**).

### Design

**Site characteristics:** Well-distributed and naturalised in the UK, and could be considered as a typically **minor** component of some seasonally flooded or permanently damp sites (e.g. by watercourses and floodplains) in some parts of lowland UK (**WL**). Tolerates a wide variety of soils, provided roots have access to water<sup>19</sup>.

**Structures:** Requiring open wooded habitats, and will establish well as more open grown trees in glades (**owh/gl**).





## Initiate

**Dispersal/natural colonisation:** Most regeneration from wind-dispersed seed might be expected within 200 metres of seed-producing trees<sup>14</sup>, if the right soil conditions are present. Willows form both ectomycorrhizas and arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Direct seeding of white willow is probably not an option. It has highly recalcitrant seeds (short-lived, highly perishable with problematic storage). Suckering from existing trees is possible, but like black poplar – which shares a similar ecology and floodplain habitat – planting is typically required where it is not already present, with material sourced and grown in the UK.

## Establish

Likely to require protecting from herbivore impacts. It is strongly light demanding and does not tolerate shade. Once established, it can be pollarded or coppiced and can readily reproduce from suckers or from adventitious roots, and is noticeably tolerant to inundation<sup>19</sup>. Like black poplar and purple willow, white willow benefits from dynamic riparian ecosystems, where naturalised river channels and floodplains provide supply of new sites for colonisation.



ALASTAIR HOTCHKISS

Willow supports many fungi including ectomycorrhizal species and many decaying saprotrophs including the willow bracket (*Phellinus igniarius*).



COLIN LEGG/WTML

## Yew (*Taxus baccata*)

### Ecological characteristics

**Status:** evergreen, native coniferous tree

**Height:** 20+ metres

**Girth:** potentially to 10+ metres

**Longevity:** potential for very long life (1,000+ years)

**Shade:** 4.4

**Drought:** 3.0

**Waterlogging:** 1.3

**Herbivory:** 1.5

**Fertility:** 2.5

**Supports:** a wide range of birds – its fruits being an important source of food for, for example, thrushes, starling and robin; while its seed is eaten by greenfinch, bullfinch and hawfinch. Although fairly poor in yew-associated species (e.g. plant-feeding insects)<sup>39</sup>, like all native trees it has some very specialist associates (e.g. *Opegrapha* lichens). In otherwise deciduous woods, its evergreen cover is also important for bird roosting and specialist invertebrates like spiders (e.g. triangle spider). A total of 140 species of fungi, lichen and slime mould have been found on yew wood and leaves<sup>65</sup>.

### Design

**Site characteristics:** Typically a relatively **minor** component of wooded habitats on very calcareous soils (**BL/BU**) over chalk, limestone or sometimes other geologies, such as base-rich igneous rocks. Rarely on more acidic, rocky soils.

**Structures:** Can be represented across a range of densities from within denser groves (**gr**), where it can occasionally form distinctive yew-dominated stands. However, it also occurs as open grown trees in more open wooded habitats and glades (**owh/gl**), where it can also regenerate.



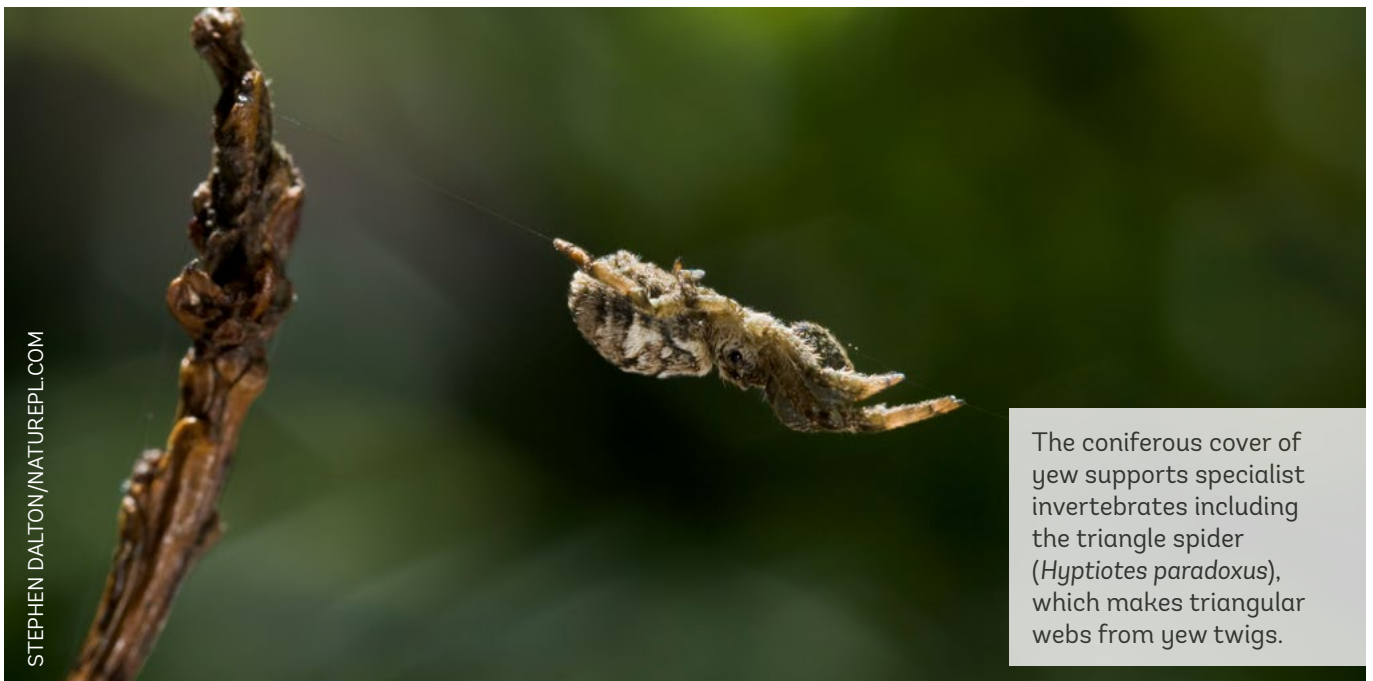
## Initiate

**Dispersal/natural colonisation:** Natural colonisation through bird-dispersed seed, mainly by thrushes, starling and to a lesser extent by other birds, such as blackcap and robin<sup>39</sup>. These can establish in more open situations as well as in deep shade. The presence of other fruiting shrubs and perches visited by birds will influence where seed moves, It forms arbuscular mycorrhizas, and associated fungi in or near a site may support colonisation.

**Direct seeding and/or planting:** Where natural colonisation is unlikely, then consider planting local provenance material in appropriate areas, with trees sourced and grown in the UK. It is intolerant of severe and prolonged frost, which damages leaf tissues.

## Establish

It is sensitive to browsing and will need to be protected from high herbivore impacts for a prolonged period, as it is very slow growing<sup>65</sup>. Dioecious (male and female flowers on different plants). Although tolerant of shade, saplings can die or show poor growth with few leaves when beneath deep shade (e.g. of beech). Likely to be relatively resilient to climate change, and distribution is to face little change<sup>65</sup>.



The coniferous cover of yew supports specialist invertebrates including the triangle spider (*Hyptiotes paradoxus*), which makes triangular webs from yew twigs.



## Species not included in the handbook

Some native tree and shrub species do not make it into the handbook, and these are listed below. There may be as many as 154 native tree and shrub species in the UK (including the 57 elm and 43 whitebeam microspecies, as well as 14 willows), and in reality, hybridisation between genera (e.g. birches, willows, oaks) only furthers the spectrum of diversity. The native species not included are those which are either **very rare or highly geographically isolated**. The establishment of many of these may be an important part of local conservation projects, but they will almost always be dedicated **species-specific projects** involving local translocations, rather than part of more general woodland creation projects – excepting montane willows, which will be the focus of specific **montane scrub** restoration projects.

The species not covered in this handbook include:

- **Whitebeam (*Sorbus*) microspecies** (following Rich et al.<sup>48</sup>). These include all *Sorbus* species other than rowan (*S. aucuparia*), wild service tree (*S. torminalis*) and common whitebeam (*S. aria sens str*). It includes 43+ native species of whitebeam, 35 of which are endemic to Britain and two to Ireland. Microspecies of whitebeam can be highly geographically limited and difficult to identify:
  - o Some are restricted to just a few crags, like Stirton's whitebeam (*Sorbus stirtoniana*) or Rich's whitebeam (*Sorbus richii*).
  - o Others might be widespread, but still rare, such as rock whitebeam (*Sorbus rupicola*) or even locally frequent, but within a small geographical area, like Devon whitebeam (*Sorbus devonensis*) in southwest England. Some of these may be more relevant and appropriate to creation projects in those areas.
  - o True service tree (*Sorbus domestica*). Native to small areas of coastal cliffs around the Bristol Channel, and known from Wyre Forest in Worcestershire.
- **Elm (*Ulmus*) microspecies** (following Sell & Murrell<sup>51</sup>). These include all *Ulmus* spp., apart from the large rough-leaved wych elms (*Ulmus glabra* and *Ulmus scabra*). Recent classification of the complex elm genus includes at least 57+ native microspecies, including the smaller and smooth-leaved species. Their biogeography is unclear, although many are likely to have quite narrowly defined geographical ranges. Some very local propagation projects of well-studied elm specimens might be very appropriate, but this will require being confident with identification and knowledge of local elm trees. Dutch elm disease has killed most of the tallest, finest elm trees, and many species persist as small suckers which can make identification more challenging, but still possible. Examples include:
  - o those which characterise the counties of central and eastern England, such as Hayley elm (*Ulmus haleyi*), Cambridge elm (*Ulmus minor*) and fat-toothed elm (*Ulmus obesidens*)

- o those which characterise the counties of southwest England and parts of west Wales, such as small-leaved elm (*Ulmus stricta*), western elm (*Ulmus occidentalis*) and Chater's elm (*Ulmus chaterorum*)
- o some more widespread species, including Plot's elm (*Ulmus plotii*) in areas from the East Midlands to the Chilterns and Marlborough Downs, and English elm (*Ulmus procera*), which was formerly a frequent, large, and broad-crowned tree across much of the southern half of the UK.
- **Montane scrub willow species.** These may be the focus of targeted montane scrub restoration projects, which will often require translocation, and include:
  - o least/dwarf willow (*Salix herbacea*): a mostly montane dwarf shrub of high parts of Wales, Northern England, Northern Ireland and mostly in north Scotland
  - o mountain willow (*Salix arbuscula*) in montane Scotland only
  - o downy willow (*Salix lapponum*) in montane and far north Scotland
  - o woolly willow (*Salix lanata*) in montane Scotland only
  - o net-leaved willow (*Salix reticulata*): montane and north Scotland, on base-rich crags
  - o whortle-leaved willow (*Salix myrsinites*) in montane and far north Scotland only.
- **Creeping willow (*Salix repens*).** A small shrubby willow of mostly coastal heaths and dunes, with some on inland heathy grasslands.
- **Dwarf birch (*Betula nana*).** A small shrub of montane and upland semi-natural habitats in north Scotland only. Consider as part of focused scrub-restoration projects.
- **Sea-buckthorn (*Hippophae rhamnoides*).** Native to east coastline of England only, and not to be planted as part of any woodland creation project.
- **Box (*Buxus sempervirens*).** Native only to very few sites on chalk in Surrey and the Chilterns.

It is difficult to know where to draw the line with smaller, woody shrubs, and the figure would be much higher if shrubs such as wild roses, honeysuckle, gorse, broom and ericoids (heather, etc.) were included. In reality, any distinction becomes meaningless. Some of these smaller, native woody shrubs are sometimes considered in woodland creation projects, but usually as part of wider translocations of vegetation and other species (see main guide, chapter 6: Establish).

### **Additional species for other objectives**

There are many other **non-native species** which contribute to the suite of ecosystem services provided by trees and shrubs in the UK. Some are planted to deliver wider provisioning services (e.g. fruit and nut-producing species and cultivars), or cultural services (e.g. ornamental urban street trees). Where these are primary objectives, then consideration may be given to additional non-native species. While some of these will contribute shared functions that support some associated native wildlife, their overall role in nature recovery and ecological

resilience is likely to be less than the combined suite of trees and shrubs listed in this handbook. Some examples include:

**Fruit and nut-producing species and cultivars:** many of these species may be important for agroforestry objectives, including walnut (*Juglans regia*) and apples (*Malus domestica*), which have numerous distinctive and important local varieties. Walnut may share some ecological functions and associated species with ash, but none that are unique or not provided by native species in the tables. Wild/crab apple and wild pear are both included in the list, and wild plum/bullace (*Prunus domestica*) is mentioned alongside blackthorn (*Prunus spinosa*), as close species with similar associated wildlife.

**Other culturally important trees:** these include London plane (*Platanus x hispanica*) and horse chestnut (*Aesculus hippocastanum*). London plane is a non-native, but culturally important tree in towns and cities, with many properties that make it a choice street tree, while horse chestnut is also a non-native, but culturally important tree which can support invertebrates of decaying wood, pollinators and lichens of nutrient-rich bark.



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