# Definition of Favourable Conservation Status for wet woodland

Defining Favourable Conservation Status Project

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# Acknowledgements

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# Executive summary

This document sets out Natural England's view on favourable conservation status for wet woodland in England.

Favourable conservation status is the situation when the habitat can be regarded as thriving in England and is expected to continue to thrive sustainably in the future. The definition is based on the available evidence on the ecology of wet woodland. Favourable conservation status is defined in terms of three parameters: natural range and distribution; extent; structure and function attributes (habitat quality).

A summary definition of favourable conservation status in England follows. Section 1 of this document describes the habitat and its ecosystem context, Section 2 the units used to define favourable conservation status and Section 3 describes the evidence considered when defining favourable conservation status for each of the three parameters. Section 4 sets out the conclusions on the favourable values for each of the three parameters.

This document does not include any action planning, or describe actions, to achieve or maintain favourable conservation status. These will be presented separately, for example within strategy documents.

The guidance document Defining Favourable Conservation Status in England describes the Natural England approach to defining favourable conservation status.

## Summary definition of favourable conservation status

Wet woodland occurs on poorly-drained or seasonally-wet soils and is found on floodplains, as successional habitat on fens, mires and bogs, along streams and hill-side flushes, and in peaty hollows. It occurs on a range of soil types, including nutrient-rich mineral soils and acid, nutrient-poor organic ones. It can occur anywhere where hydrological conditions are suitable. There are several types of wet woodland reflecting differences in water chemistry, water regime and topography (which influences the soil conditions).

Wet woodland would once have occurred throughout the country where soil conditions were suitable but substantial land drainage, and associated land use change, has caused a significant loss, not only of wet woodlands, but of wetland habitats more generally. The patches which remain tend to be small and isolated and many are not in good condition. Modification of natural hydrological functioning, including groundwater abstraction (leading to drying of sites) and eutrophication from nutrient pollution, are two of the main causes of unfavourable condition. Many wet woodlands are even-aged and particularly lack older trees either because of a cessation of previous woodland management or because they have become established on wetlands where former wetland management has been abandoned.

Favourable conservation status will be achieved when the current distribution within 706 hectads (10 km grid squares) is maintained and the extent is increased by 53,000 ha to approximately 131,000 ha, by increasing patch size and linking isolated patches through habitat creation. At least 95% of the favourable area of the habitat should meet the structure and function requirements including: natural hydrological function, water chemistry and water nutrient status; a diverse woodland structure; at least 95% cover of appropriate native species; presence throughout of a variety of standing and fallen deadwood and leaf litter; found in a wetland complex with other habitats appropriate to the location. All species partially or wholly dependent on this habitat should be Least Concern, when assessed using IUCN criteria.

**Table 1: Confidence levels for the favourable values**

| Favourable conservation status parameter | Favourable value | Confidence in the favourable value |
|---|---|---|
| Range and distribution | The favourable range and distribution is the current range and distribution – 706 hectads (10 km grid squares) | Low |
| Area | An increase of 53,000 ha on the current area of 78,000 ha giving a favourable area of approximately 131,000 ha | Low |
| Structure and function | At least 95% of the favourable area of the habitat meets the structure and function requirements as described in Section 4.3. | Moderate |

As of May 2022, based on a comparison of the favourable values with the current values, wet woodland is not in favourable conservation status. Note, this conclusion is based solely on the information within this document and not on a formal assessment of status nor on focussed and/or comprehensive monitoring of status.

# Contents

# About the Defining Favourable Conservation Status project

Natural England's Defining Favourable Conservation Status (DFCS) project is defining the minimum threshold at which habitats and species in England can be considered to be thriving. Our Favourable Conservation Status (FCS) definitions are based on ecological evidence and the expertise of specialists.

We are doing this so we can say what good looks like and to set our aspiration for species and habitats in England, which will inform decision making and actions to achieve and sustain thriving wildlife.

We are publishing FCS definitions so that you, our partners and decision-makers can do your bit for nature, better.

As we publish more of our work, the format of our definitions may evolve, however the content will remain largely the same.

This definition has been prepared using current data and evidence. It represents Natural England's view of favourable conservation status based on the best available information at the time of production.

# 1. Habitat definition and ecosystem context

## 1.1 Habitat definition

This definition covers the wet woodland Priority Habitat which occurs on poorly-drained or seasonally-wet soils, usually with alder *Alnus glutinosa*, birches *Betula* spp. and willows *Salix* spp.as the predominant tree species, but sometimes including ash *Fraxinus excelsior*, oak *Quercus* spp. and beech *Fagus sylvatica* within drier areas. Wet woodland is found on floodplains, as successional habitat on fens, mires and bogs, along streams and hill-side flushes, and in peaty hollows. These woodlands occur on a range of soil types including nutrient-rich mineral soils and acid, nutrient-poor organic ones (BRIG 2011).

Wet woodlands can be defined by several characteristics, including geographic location, main canopy component, topography, location in the landscape, hydrological system producing the wet soils, hydrological conditions (base status, water regime etc), origin and management. Miller (2012) provides an overview of the diversity of wet woodlands and the different classification systems used to define the habitat. Appendix 1 (adapted and expanded from Miller 2012) provides a summary of different woodland types identified using the more influential classifications systems; for context ‘all woodland’ is also included.

The National Vegetation Classification (NVC) is currently the most widely utilised classification of habitats within England. In terms of the NVC communities, wet woodland in England is characterised by the following (BRIG 2011):

Willow

- W1 *Salix cinerea - Galium palustre* woodland.
- W2 *Salix cinerea - Betula pubescens - Phragmites australis* woodland.
- W3 *Salix pentandra - Carex rostrata* woodland.

Birch

- W4 *Betula pubescens - Molinia caerulea* woodland.

Alder

- W5 *Alnus glutinosa - Carex paniculata* woodland.
- W6 *Alnus glutinosa - Urtica dioica* woodland.
- W7 *Alnus glutinosa - Fraxinus excelsior - Lysimachia nemorum* woodland.

Wet woodland in England encompasses two habitats listed on Annex I of the Habitats Directive and which are therefore considered to be UK habitats of European importance:

1. H91D0 Bog woodland.
2. H91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*).

Bog woodland is woodland on a humid to wet peaty substrate, with a permanently high water level. The water is always poor in nutrients. Scattered trees occur across the surface of the bog in a relatively stable ecological relationship as open woodland, without the loss of bog species. This true bog woodland is rare within the UK and it is debatable whether it occurs within naturally functioning ecosystems within England. However, birch or willow-dominated types within minerotrophic mires are also recognised as bog woodland and occur within England. These communities are generally dominated by downy birch *Betula pubescens* with species specific to oligotrophic environments such as bilberries *Vaccinium* spp., bog mosses *Sphagnum* spp. and sedges *Carex* spp. (European Commission 2013). Woodland on degraded bogs, and woodland encroaching on bogs due to falling water levels, are excluded from this definition.

H91E0 Alluvial forests are ash and alder woodlands along spring lines and rivers, on heavy soils (generally rich in alluvial deposits) which may be periodically inundated by the annual rise of the river (or brook) level, but otherwise well-drained and aerated during low water. The herbaceous layer includes species such as meadowsweet *Filipendula ulmaria*, wild angelica *Angelica sylvestris*, bitter-cresses *Cardamine* spp., wood dock *Rumex sanguineus*, sedges *Carex* spp., lesser celandine *Ficaria verna* and wood anemone *Anemone nemorosa*. (European Commission 2013).

**Table 2: Relationship between Annex I, EUNIS and NVC wet woodland classifications (based on Miller 2020)**

| Annex I habitat | EUNIS code and EUNIS habitat | NVC code and NVC community |
|---|---|---|
| **H91D0: Bog woodland** | T1.6 Broadleaved swamp forest on acid peat<br>T1.61 Sphagnum *Betula* forests | W4c - *Betula pubescens* - *Molinia caerulea* woodland: *Sphagnum* sub-community |
| **H91E0: Alluvial forest** | T1.1 Temperate and boreal *Salix* and *Populus* riparian forest<br>T1.11 Temperate and boreal riverine *Salix* forest | W6 (where alder low/ absent) - *Alnus glutinosa* - *Urtica dioica* woodland |

| Annex I habitat | EUNIS code and EUNIS habitat | NVC code and NVC community |
|---|---|---|
| | T1.2 Riparian *Alnus* forest<br>T1.21 Riverine *Fraxinus - Alnus* forest, wet at high but not at low water | W5 - *Alnus glutinosa - Carex paniculata* woodland<br>W6 - *Alnus glutinosa - Urtica dioica* woodland<br>W7 - *Alnus glutinosa - Fraxinus excelsior - Lysimachia nemorum* woodland. |
| **Non-Annex 1 woodland habitats**<br>**N.B. May form part of bog and mire Annex I habitats** | F9.2 Willow carr and fen scrub | W1 - *Salix cinerea - Galium palustre* woodland<br>W2 - *Salix cinerea - Betula pubescens - Phragmites australis* woodland<br>W3 - *Salix pentandra - Carex rostrata* woodland<br>Possibly W6 - *Alnus glutinosa - Urtica dioica* woodland |
| | T1.5 Broadleaved swamp forest on non-acid peat | W5b - *Alnus glutinosa - Carex paniculata* woodland: *Lysimachia vulgaris* sub-community |
| | T1.51 *Alnus* swamp forests not on acid peat | W5 - *Alnus glutinosa - Carex paniculata* woodland |
| | T1.62 *Alnus* swamp forests on acid peat | |
| | T1.G21 Atlantic *Alnus glutinosa* forests | W6 - *Alnus glutinosa - Urtica dioica* woodland |

The following sections in this definition will focus on wet woodlands in England based on the NVC communities. However, in some instances it may be more appropriate to consider the hydrological or topographic characteristics rather than the defining flora.

## 1.2 Habitat status

Wet woodland is a Habitat of Principal Importance in England under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006, reflecting its high conservation value.

Woodlands that meet the Annex 1 definitions may be protected through designation as Special Areas of Conservation (SAC). England makes a relatively small contribution to the number of European sites: eight sites for H91D0 Bog woodland (includes one site overlapping with Wales) of 4,388 Natura 2000 sites across Europe and 30 sites for H91E0 Alluvial forest (includes two sites overlapping with Wales and one with Scotland) of 6,647 sites across Europe (EEA 2019a,b;JNCC 2019).

In the latest Article 17 reporting for Annex I habitats the status of UK H91D0 bog woodland was reported as Unfavourable - Inadequate and H91E0 Alluvial forest as Unfavourable – Bad (JNCC 2019).

In the European Red List of Habitats (Janssen and others 2016) broadleaved bog woodland on acid peat was classed as Vulnerable, temperate and boreal softwood riparian woodland Near Threatened, *Salix* fen scrub Near Threatened; temperate and boreal hardwood riparian woodland Endangered and broadleaved swamp woodland on non-acid peat Vulnerable.

## 1.3 Ecosystem context

Wet woodlands can occur anywhere where hydrological conditions are suitable. The different woodland types are largely associated with differences in water chemistry and regimes and topography which influences the soil conditions and therefore the herb component. Wheeler and others (2001) also found light penetration and fertility to be important in explaining variation in wet woodlands. The seven NVC communities that encompass wet woodlands (W1 – W7) reflect different hydro-ecological conditions.

Many wet woodland types are associated with waterways and riparian zones and, as a consequence, they are often narrow and linear. Others may be found in association with open water lakes, on raised plateaus and peat bogs where they may form extensive patches.

Wet woodlands are typically found in mosaic or in transition with other woodland types and with wetland habitats such as lowland fen, purple moor-grass and rush pasture, coastal and floodplain grazing marsh, blanket bog, raised bog and occasionally reedbed. As a generalisation, willow and birch wet woodland are usually associated with open habitats and alder wet woodlands are associated with a range of open and woodland habitats.

When associated with open herbaceous habitats, wet woodland typically occurs where the land is drier, for example at the periphery or on raised land; such situations may be natural or human induced. The nature of the association is highly complex and varies with

geographic location, topographic location, hydrological systems, seasonal trends in ground water, flood events and weather. Such complexities are considered further by Wheeler and others (1999). Functioning raised bogs support a 'lagg zone' of wetland habitats at their periphery, which may include wet woodland, creating a natural transition to adjacent land uses and help maintain the hydrological integrity of the whole system (for example, Mackin and others 2017).

Many ancient woodlands include patches of wet woodland and are generally biologically richer and more valuable for some groups of species and conservation features than woodland that has developed within the last 300-400 years on previously open ground (Peterken 1977).

Wet woodlands are also commonly associated with different deciduous woodland types. For example, plateau alder woodlands in eastern England have strong associations with acidic limewoods, ash-lime woods and chestnut-hornbeam woods (Rackham 2003). "The boundaries with dryland woodland may be sharp or gradual and may (but not always) change with time through succession, depending on the hydrological conditions and the treatment of the wood and its surrounding land" (BRIG 2011).

Floodplain woodland is very scarce in England (Peterken & Hughes 1995) but, within these woodlands, poplar and willow woodland often occurs on relatively free-draining soils formed from deposited sand and gravel next to active channels whereas alder woodland is often found in more waterlogged areas including silted-up oxbow lakes and abandoned channels (Dyson 2020). Floodplain wet woodlands, particularly W7 *Alnus glutinosa - Fraxinus excelsior - Lysimachia nemorum* woodlands, are often associated with ash dominated woodland, most likely W8 *Fraxinus excelsior - Acer campestre - Mercurialis perennis* woodland.

## Ecosystem services

Wet woodland (or features associated with wet woodland) have a role in the provision of ecosystem services including:

- Reducing the effects of climate change (Read and others 2009; NE & RSPB 2019; Quine and others 2011):
    - Flood risk management (wet woodlands in the riparian zones).
    - Maintaining freshwater temperatures, for example to protect fisheries.
    - Bioenergy: provision of wood fuel as an alternative to fossil fuels (managed short-rotation willow or poplar).
- Carbon storage and sequestration (Read and others 2009)
    - Soil carbon stocks – peat soils store more carbon than all other soils and gley soils typically more than brown earths. Since many wet woodland types are associated with peat or gley soils they can be considered an important carbon store.
    - Timber carbon content ($tCO_2e\ m^{-3}$) varies with tree species. Broadleaves (for example, oak 1.12 $tCO_2e\ m^{-3}$) are typically greater than conifers (range 0.6 to

0.9 $tCO_2e\ m^{-3}$). Example wet woodland species range from 0.83 $tCO_2e\ m^{-3}$ (alder) to birch and ash (1.10 $tCO_2e\ m^{-3}$).

- Nitrogen fixing (alder) – mixed planting of alder with timber crops to enhance timber growth (Read and others 2009).
- Erosion management (NE & RSPB 2019; Quine and others 2011).
- Water quality (NE & RSPB 2019; Quine and others 2011).
- Biodiversity (Quine and others 2011).

# 2. Units and attributes

## 2.1 Natural range and distribution

Hectads (10 km grid squares)

Hectads have been used in determining the natural range and distribution of Annex 1 wet woodland habitats. Also, as wet woodlands can occur anywhere with suitable hydrological conditions, hectads are considered to be appropriate.

## 2.2 Extent

Hectare

## 2.3 Structure and function attributes

The following structure and function attributes are based on the woodland and fen woodland attributes identified in the Common Standards Monitoring (CSM) guidance for site level monitoring. They have been refined based on features more specific to wet woodlands and the relative importance/requirements of their associated species groups.

### Structure attributes

#### Deadwood and leaf litter

A high number of invertebrates associated with wet woodland utilise deadwood in their larval stage, therefore a diversity of deadwood features is a key attribute of habitat quality. Secondary attributes are:

- standing – particularly important to nesting birds and roosting bats.
- fallen
- stumps
- saturated/associated with wet features such as seepages - particularly important to flies, notably craneflies.
- debris dams – where woodland is associated with flowing water, important for invertebrates.
- mixed diameter.

Some invertebrates require/are associated with thick leaf litter or standing dead herbaceous plants over the winter period.

#### Vertical age structure

The woodland should have a varied vertical structure, comprising differing layers of vegetation across a range of age classes:

- Canopy layer and old and veteran trees
- Secondary canopy of medium sized/aged trees
- Shrub layer (including young trees)
- Ground flora layer (including bare ground)
- Regeneration.

Following a literature and knowledge review of the value of wetland habitats, including wet woodland, Wheeler and others (1999) found both vertical and horizontal structure was important along with strata and mosaic diversity.

**Spatial variation**

Open areas are particularly important for natural regeneration of key component species as well as associated flora and fauna. Open areas can be either within the woodland patch or associated/adjacent habitats such as wet grassland, marsh, reedbed as part of a wider ecosystem/landscape mosaic. They include both temporary and permanent open spaces.

For fen and bog wet woodland types, open space is more significant, for example to maintain the associated *Sphagnum* communities.

Equally there should be areas of closed canopy away from edge habitat where humidity remains high and there is little wind. Such conditions are required by some invertebrates and consequently by foraging bats and birds.

Micro-variation is also important for example, fallen trees resulting in vertical root-plates and associated hollows.

**Associated habitats**

Natural transitions to, and associations with, other habitats are important for the diversity of the flora and fauna of wet woodland.

**Hydrological and soil micro-features**

Features such as seepages and water-filled rot holes are important features of wet woodland in terms of associated invertebrate communities, notably craneflies. Seepages and hollows are also important in some wet woodland types for lower plants, such as *Sphagnum* spp.

Surface water and standing water (for example ponds, small temporary water features) and associated marginal vegetation can be integral to certain woodland and invertebrate communities.

**Vegetation composition**

Different wet woodland types have different characteristics, for example alder-dominated or willow-dominated, which occur across the habitat’s range. Some types, however, are specific to geographical locations or topographical/hydrological situations, for example:

- W3 *Salix pentandra-Carex rostrata* woodland is a northern wet woodland type
- H91D0 Bog woodland is associated with raised bogs.

Similarly, associated flora and fauna will have varying geographic natural ranges which may be localised or more widespread.

Non-native invasive species and inappropriate native species are undesirable and generally have a negative impact on overall biodiversity quality. For example, there is no strong evidence that native pine has persisted as part of any bog woodland in England.

Invasive species can be detrimental to the woodland habitat at a site scale but some species, such as Himalayan balsam, may affect the habitat at a wider scale on account of its rapid dispersal along watercourses.

### Pests and disease

Diseases such as alder rot disease (*Phytophthora alni)* or ash die-back have the potential to alter the structure and species composition of the habitat. Depending on the nature of the disease, the resultant deadwood, if left in place, may have potential benefits to the deadwood communities and creating gaps for new recruits or new species to establish. However, should the dead or diseased trees remain a source of the disease this would only be a localised benefit for the short term.

## Function attributes

### Hydrological functioning

Different wet woodland types tolerate different soil drainage and flooding conditions (EA 2009). Changes to the eco-hydrological functioning of wet woodlands (that is, where water comes from, how it moves through the site, its quantity, chemistry and nutrient status) can lead to changes in vegetation composition with a decrease in habitat quality or a move towards a different habitat type. Quality can be affected by activity that influences water levels as well as flora composition, for example drainage ditches, back-channels within and outside the woodland habitat.

Waterborne nutrient enrichment and other pollutants can have significant effects on the flora of wet woodlands, often leading to a reduction of diversity and subsequently affecting invertebrate communities and fauna higher up the food chains. Nutrient enrichment can also result in a shift of wet woodland type, for example from W5 to W6.

### Soil characteristics

Woodland composition and structure should vary in relation to natural soil characteristics.

### Air quality characteristics

Higher concentrations and deposition of air pollutants, in particular atmospheric deposition of nitrogen, can lead to nutrient enrichment, with resulting shifts in the flora and a loss of quality.

**Vegetation management**

In naturally functioning wet woodlands a diverse structure will develop and be maintained by natural disturbance effects such as storms and flooding, which can bring down mature trees, create patches of bare ground and bring in materials such as gravels. When trees fall, and their root plates are lifted out of the ground, micro-features, which are important for invertebrates, are created together with small areas where light and humidity levels are increased at ground level allowing the regeneration of trees, shrubs and other plants.

Low levels of grazing or browsing can contribute to the creation and maintenance of a diverse structure but overgrazing can lead to a lack of structure, loss of the shrub layer and no regeneration or future shrub or canopy recruitment.

**Connectivity**

Connectivity between habitats across a landscape will ensure opportunity for recruitment and genetic exchange to maintain robustness of wet woodland at a landscape scale. Given the association with other habitats (wetlands, mesic woodland etc) and that few species are solely reliant on the wet woodland (also occurring in other habitats), connectivity can include features such as wetlands, hedgerows, mesic woodland, watercourses, meadows.

**Other sources:** Boyce 2002; RSPB & EA 2016.

# 3. Evidence

## 3.1 Current situation

### Natural range and distribution

The natural range is considered to cover the entire country where soil and hydrological conditions are appropriate. While wet woodland is largely ubiquitous across the country, different types of wet woodland may be restricted to specific geographical or topographical locations as summarised in Appendix 2. For example, W3 is very much a northern wet woodland type.

Based on the data shown on Figure 1 below, wet woodland occurs within 706 hectads (47% of squares in England)

- Annex 1 wet woodland habitats
    - H91D0 Bog woodland: 29 hectads (2% of squares in England)
    - H91E0 Alluvial woodland: 354 hectads (24% of squares in England)
- SSSIs with a wet woodland component
    - 427 hectads (29% of squares in England)
- Non-annex 1 wet woodland habitats
    - 703 hectads (47% of squares in England)

NB totals do not sum because some squares support separate sites of Annex 1, SSSI and non-Annex 1 habitats.

Figure 1 is based on the following sources:

- SSSI Condition assessment database (Confidence: Moderate)
- JNCC NVC database (Confidence: Moderate)
- Local data: Barnsley; Leicestershire & Rutland; Northamptonshire; various site-specific studies (Confidence: High - Moderate)
- Miller (2012) (Confidence: High)

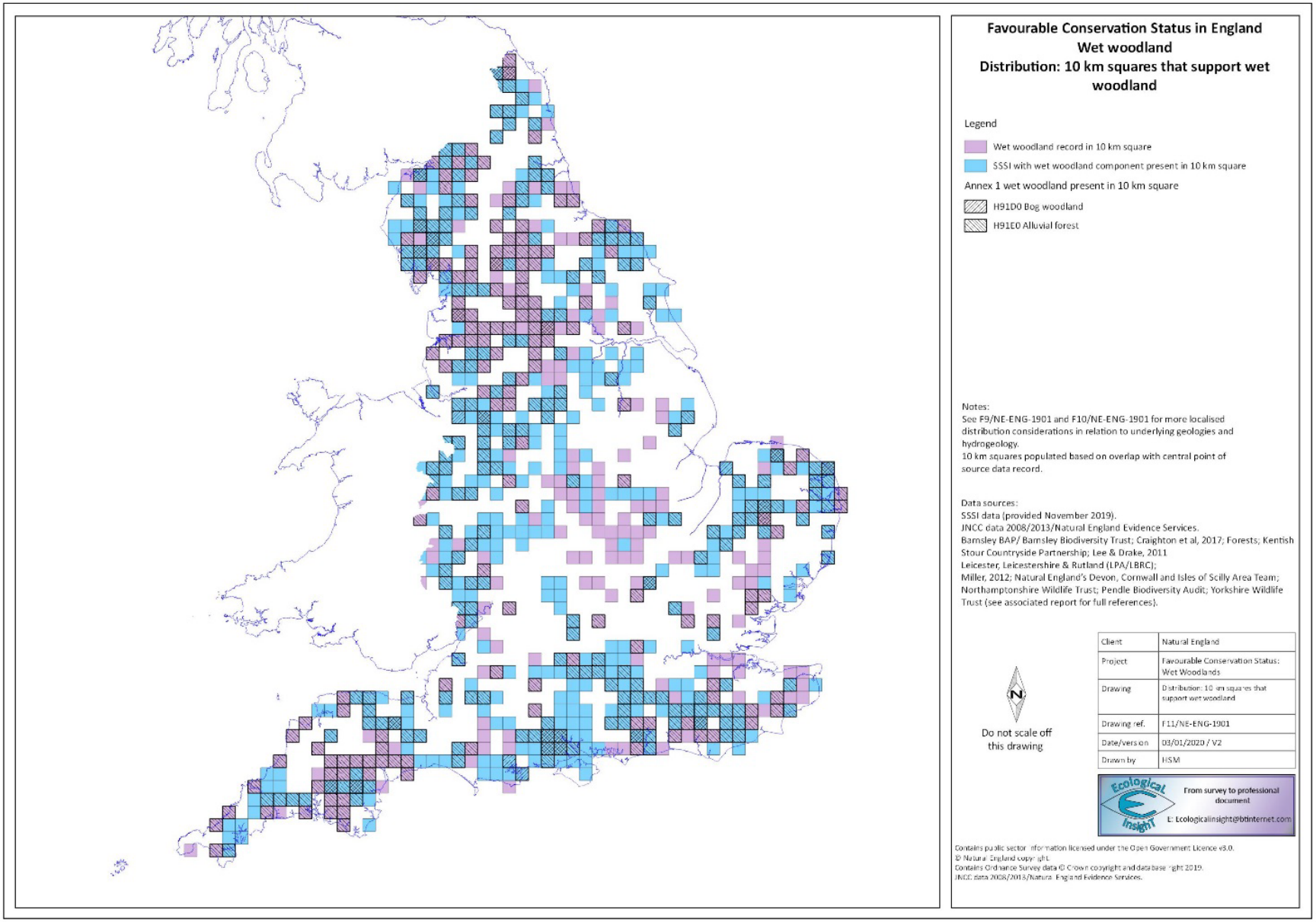



**Figure 1: Distribution of wet woodland in England (from Miller 2020) © Natural England copyright. Contains Ordinance Survey data © Crown copyright and database right 2019.**

The National Forest Inventory (NFI; Forest Research 2020) identified just 352 hectads with wet woodland (see map at Appendix 3). The NFI uses a combination of earth observation and surveys of approximately 6,200 one-hectare sample squares that partially or entirely contain woodland (including clear-felled areas). The 352 hectads are the hectads where wet woodland was identified within NFI sample squares. The patchy distribution and small patch size of wet woodland make it less likely to be identified in a sample survey therefore this figure is believed to under represent the distribution of wet woodland. The figure of 706 hectads is considered to be more accurate and is taken as the current distribution of the habitat.

## Extent

**Annex 1 wet woodland habitats** (Confidence: High):

The 2019 Article 17 data (JNCC 2019) reported the following areas for Annex 1 wet woodland habitats:

- H91D0 Bog woodland: 326 ha
- H91E0 Alluvial forests: 1,805 ha
- Total: 2,131 ha

**All wet woodland types** (Confidence: Low-Moderate)

The NFI (Forest Research 2020) estimates there is around 78,000 ha of wet woodland in England. Again, caution must be applied to this figure because it is based on a sample survey. Therefore, the figure is likely to be the right order of magnitude, but not precise.

## Patch size and connectivity

Data from the NFI indicates that approaching two thirds of all wet woodland occurs in patches less than 20 ha in extent and over one third in patches less than 5 ha in extent. However, these figures should be taken with caution as they are extrapolated from samples and the patchy distribution of wet woodland is likely to lead to greater inaccuracy than for less patchily distributed woodland types.

**Table 3: Proportion of different woodland size categories that include wet woodland**

| <5ha | >=5 ha and <10 ha | >=10 ha and <20 ha | >=20 ha and <50 ha | >=50 ha and <100 ha | >=100 ha and <150 ha | >=150 ha and <200 ha | >200 |
|---|---|---|---|---|---|---|---|
| 35% | 12% | 14% | 17% | 9% | 2% | 4% | 6% |

Information in Miller (2020), from a range of local data sources and studies, confirms a small median patch size as did the results of a targeted questionnaire sent to relevant

landowners/managers and a literature search (Miller 2012). The latter found that the most frequent wet woodland size was less than 4 ha.

**Confidence:** Low

## Quality of habitat patches

The information available implies that many wet woodlands are in sub-optimal condition.

Annex 1 habitats (H91D0 and H91E0) are currently reported as having 'bad but improving' structure and function (JNCC 2019).

Based on the available data (Natural England 2019), SSSI condition assessments indicate the following proportions of SSSI units for each wet woodland type are in favourable condition:

- Annex 1 wet woodland habitats
    - H91D0 Bog woodland: 40% (NB 12% not assessed so equates to 45% of units excluding those not assessed)
    - H91E0 Alluvial woodland: 53% (NB 7% not assessed so equates to 57% of units excluding those not assessed)
- Non-annex 1 wet woodland habitats
    - 45% (NB 24% not assessed so equates to 60% of units excluding those not assessed).

However, these assessments are based on SSSI units rather than wet woodland habitat and, as these sites have a degree of legal protection to ensure the quality is maintained, the dataset is likely to provide a positively-biased assessment of quality of the habitat across the country, with the proportions of individual habitats in favourable condition an overestimate.

Natural hydrological processes are central to the maintenance and restoration of wet woodlands and modification of natural hydrological functioning, including groundwater abstraction (leading to drying of sites) and eutrophication from nutrient pollution, are two of the main causes of unfavourable condition of terrestrial wetlands on designated sites. The hydrology of most, if not all, terrestrial wetlands within European Sites has been modified by historic drainage both within sites and in the wider landscape (Wetherell and others 2015). The 2021 state of the water environment in England report notes that only 14.8% of SSSI units underlying European wetland sites are in favourable condition. More generally, the report notes that only 14% of rivers and lakes achieved good ecological status, 73% of assessed groundwater bodies met good quantitative status but only 45% achieved good chemical status, with nitrates being the most common cause of test failure.

In a study of 1,368 wetland sites, including wet woodland sites, Whiteman and others (2010) found that 4% were at high risk from abstraction and 9% at high risk from groundwater chemical pressures. However, they noted that this was likely to be an underestimate of the number of damaged wetlands as there was insufficient monitoring information to assess whether significant damage had occurred at many of the groundwater-dependent terrestrial ecosystems. A specific case study from Hurcott and

Podmore Pools SSSI in Worcestershire, which includes a large area of wet woodland, concluded that the effects of abstraction of groundwater were a major contributor to the damage to the site.

Many wet woodlands are even aged because they have become established on wetlands where former wetland management has been abandoned (forming young woodlands) or, in some instances, as a result of the cessation of previous coppice management (forming old woodlands).

The effects of air pollution are all-pervasive: Rowe and others (2020) found that all of the managed broadleaved woodland and unmanaged woodland resource exceeded nitrogen critical loads and half of managed broadleaved woodland and a third of unmanaged woodland exceeded acidity critical loads.

The NFI (Forest Research 2020) contains data on the following ecological condition indicators. The assessments cover all types of woodland but do not include information on hydrology, of key importance for wet woodland.

- Age distribution of trees
- Wild, domestic and feral herbivore damage
- Invasive plant species
- Number of native tree species
- Occupancy of native trees - The percentage area of native tree species in the uppermost canopy relative to total uppermost canopy area
- Open space within woodland
- Proportion of favourable land cover around woodland
- Woodland regeneration
- Tree health
- Vegetation and ground flora
- Woodland vertical structure
- Veteran trees
- Volume of deadwood

The results for wet woodland suggest that the main issues are:

**A lack of older trees**

Just 14% of the sampled wet woodland had all three age classes of tree. 57% of woodland had only young and intermediate aged trees, 15% young only and 12% intermediate only.

**Habitat fragmentation**

Just over 14% of wet woodland had 20% or more favourable land cover (woodland or other semi-natural habitat) within 100 $km^2$ circle of the sampled woodland (considered favourable).

**Low numbers of veteran trees**

99% of sampled woodland had no veteran trees but note that the sampling method may have led to some under-estimation of the number of veteran trees.

**Low volume of deadwood**

Only 5% of the sampled wet woodland had levels of dead wood present considered favourable.

**Confidence:** Low

## Threatened species

The following are examples of threatened species associated with wet woodland. The confidence is given as Low to Moderate for this section because there is currently no comprehensive review of the threatened species associated with wet woodland.

**Birds**

Of the birds associated with wet woodland, the willow tit (assessed using IUCN criteria as Endangered) is likely to be one with strongest links to and benefits from the habitat (YWT & RSPB). Wet woodland is also important for woodcock (Vulnerable) and may be important for nightingale (Vulnerable) and marsh warbler (Critically Endangered).

**Mammals**

Eurasian beaver (Endangered) is associated with freshwater habitats particularly where wet woodland is present and, after becoming extinct in England, is currently re-establishing at a small number of sites.

The Bat Conservation Trust state that Bechstein's bat (Vulnerable) shows a preference for wet woodlands with small streams. It is not dependent on wet woodland and is principally associated with large mature woodland blocks with old trees.

**Invertebrates**

Wet woodland is perhaps most important for invertebrates and supports some that show a degree of habitat fidelity. Panter and others (2011) found that of species with a primary association with fen carr and scrub in the Broads, approximately 93% were invertebrates, the majority being true flies followed by beetles.

A search (26/11/2019 by H. Miller) of the Pantheon database (Webb and others 2018) returned 278 species (2.4% of species in the database) that had 'wet woodland' listed as a habitat in England. Of these 278:

- only four solely listed wet woodland, the remaining 274 included other habitats such as marshland, tall sward/scrub, shaded woodland floor, running water and peatland.
- 82% were flies.
- 17% were beetles.

Of the 278 invertebrates associated with wet woodland, Pantheon records the following assessments:

- 3% are IUCN red listed as Critically Endangered, Endangered, Vulnerable or Near Threatened.
- 37% have other listings, such as RDB status using the pre-1994 criteria, S41 listed, data deficient.
- 60% have yet to be assessed.

Of the invertebrate species recorded from woodland seepages in England approximately 50% were at least notable (notable status correct at time research was reported in 2002) (Boyce 2002). Boyce noted that of the four snails recorded, "*the populations occurring in Britain form a major part of the world total*".

As a local scale example Wolton and others (2017) identified 845 species of Diptera at a wet woodland (W7a) and wet grassland site in Devon. Of these:

- 67 (8%) species were considered to be threatened or near threatened with extinction in Britain, or nationally rare or nationally scarce ('notable' species); 25 (37%) of which had larvae associated, although not necessarily exclusively, with deadwood and five (7%) with larvae associated with wet soils or mud.
- 13 (2%) species considered to be wet woodland specialists.
- two species (<1%) wet grassland specialists of the rare or near threatened species.

They also reported that similar findings were found on other North Devon sites for Diptera and Coleoptera, that is, most 'notable' species were associated with wet woodlands more than wet grasslands. The groups that were most species-rich were fungus gnats, hoverflies and craneflies.

**Plants**

Coralroot orchid *Corallorhiza trifida* (Vulnerable) is mostly found in wet or damp woodland as is elongated sedge *Carex elongata* (Near Threatened).

Ghostwort (*Cryptothallus mirabilis)* is found in wet birch woodland and has been assessed as Near Threatened in Europe.

**Confidence:** Low – Moderate

## 3.2 Historical variation in the above parameters

Wet woodland would once have occurred throughout the country where soil conditions were suitable, particularly in floodplains, closely associated with other wetland habitats in a complex mosaic. There would have been local/regional natural fluctuations in the wet woodland resource in response to natural floodplain and river dynamics.

Substantial land drainage, and associated land use change, caused a significant permanent loss of these wetland habitats, notably in the pre-Roman and Roman period

with further periods of significant loss in the mid to late 19th century and late 20th century (Robinson 1986). At the turn of the 20th century Moss and others (1910) commented that much alder and willow woodlands had been lost to extensive drainage and the subsequent cultivation of alluvial lands: “woods of this series [alder and willow] do not now cover wide tracts of country”. 20,000 $km^2$ of riverside land was drained for flood defence and agriculture between 1940 and 1982 (Street 2003 in Miller 2012). Robinson & Gibson (2011) estimated over 100,000 ha per year were being drained in the 1970s but this loss decreased in the 1980s as grants for drainage were withdrawn. Entwistle and others (2019) note an increase in intensive agricultural landcover in floodplains from 35% to 64% between 1990 and 2015 and a decrease in floodplain wetlands (fen, marsh, swamp and bog) in the same period from 2% to less than 0.5%. Drainage of floodplains is so comprehensive that there is now little or no naturally functioning floodplain in the English lowlands with a consequent enormous loss of wetland habitat and associated species.

Even where wet woodland has not been lost, drainage and changes in flood patterns, can alter its floristic composition, resulting in a shift of wet woodland type, and alter the micro-habitats within the woodland. Wet woodlands may progress to mesic woodlands where river flow management or adjacent land drainage results in a lowering of the water table.

Anecdotal evidence suggests that, at least in some counties, in the last 25-30 years the rate of loss could be declining, woodland expansion increasing and total area stabilising. These changes vary with geographic location and wet woodland type. The literature suggests that increases relate to more planting of short-rotation fuel crops or a reduction in management of associated wetland habitats, notably fen and reedbed, enabling woodland development through natural succession (for example, see Wheeler and others 1999). Eutrophication, through changes in flood patterns and agricultural intensification, has resulted in low nutrient wet woodland types (for example, W5) developing into other types, characteristic of higher fertility, such as W6.

First noted in Britain in 1993, *Phytophthora alni*, which causes disease and death in alder trees, “is now considered to be one of the most important diseases of natural ecosystems in Europe for the last twenty years.” It is widespread across the country, and it is estimated that 20% of trees are affected, notably in the South East (Forest Research 2019). *Phytophthora* root disease is likely to have had at least localised impacts on alder wet woodland distribution.

## Natural range and distribution

The natural range of the wet woodland habitats is largely driven by edaphic, topographical and hydrological conditions which have been significantly impacted by land drainage and an increase in intensive agriculture. However, there is no evidence available on how this may have affected the range and distribution of wet woodland. Given the severity of the impacts, it is reasonable to suppose that there has been a contraction in distribution, but the effects may have differed between wet woodland types. For example, Dyson (2020) notes the almost complete loss of the poplar and willow woodland communities of floodplains in Britain.

Article 17 reporting on the Annex 1 wet woodland types indicate that the range of both habitats, currently favourable, have remained stable since approximately 1994 (JNCC 2007, 2013).

**Confidence:** Moderate

## Extent

Although there have been substantial historical losses in the extent of wet woodland, information on the exact scale of loss is limited.

### Annex 1 wet woodland habitats

Since the reporting began in 1994, both habitats have been reported as 'Stable'. It should be noted that changes in area, in part, reflect improved digitization and boundary refinements rather than actual change in area of habitat.

**Table 4: Hectarage of H91D0 and H91E0 woodland**

| Year | H91D0: Bog woodland | H91E0: Alluvial forest |
|---|---|---|
| **2006** (1) | 100 ha | 2,500 ha<br>(2,000 - 3,000) |
| **2012**(2) | 100 ha | 2,500 ha |
| **2019**(3) | 326 ha (1 site overlaps with Wales) | 1,805 ha (2 overlaps with Wales & 1 with Scotland) |
| **Notes**<br>1. JNCC (2007)<br>2. JNCC (2013)<br>3. JNCC (2019) | | |

### All wet woodland types

The Countryside Survey (NERC 2008) reported 33,000 ha of wet woodland habitat in 1998 increasing by 5,000 ha to 38,000 ha in England by 2007. The authors attributed the increase across Great Britain (all countries saw an increase) to two scenarios:

- Willow saplings recorded in 1998 were sufficiently large enough to be classified as woodland in 2007.
- The area of dry woodland at the periphery had increased such that it could be classified separately in the later survey.

Outside of the statutory reporting systems there is little consistent or comprehensive data pertaining to area change, with much being anecdotal or descriptive in local biodiversity action plans (or similar), for example:

- East of England: LUC (2009) reported that in the preceding 25 years there had been up to a 25% decline in wet woodland (and lowland mixed deciduous woodland) habitat extent.
- Ryedale: Historically declined but now probably stable (Ryedale District Council 2007).
- Lincolnshire: previously coppiced but now neglected and habitat is being lost (Farrow & Wright 2000).

**Confidence:** Low

## Patch size and connectivity

There is only descriptive anecdotal evidence relating to changes in patch size. There is a general consensus across the literature that wet woodland has become more fragmented and isolated suggesting a reduction in patch size.

**Confidence:** Low

## Quality of habitat patches

There is qualitative information suggesting that patch quality has changed over the last 100 years both positively and negatively. Directions and types of change in quality are likely to have been different in different geographic areas and locations.

Article 17 auditing suggests that there has been little change in Annex 1 wet woodlands since reporting began in 1994.

The State of the Natural Environment 2008 document (NE 2008) reported that as of 2005 wet woodland showed a positive, increasing trend in habitat condition.

Following a literature and knowledge review Wheeler and others (1999) noted that “direct intervention by man and to disruption of former natural processes” has affected the character (that is quality) of wet woodlands, for example:

- abandonment of former coppice management leads to more uniform and even-aged canopies
- direct or indirect modification to the habitat’s hydrodynamics through partial drainage or drainage of adjacent land.

Until at least the early 1900s wet woodland would probably have been actively managed, as Moss and others (1910) refer to planted coppices of alder (associated with adjacent drier woodlands) and planted osier beds on alluvial soils (rarely on peat). Currently, wet woodlands (with the exception of willow biofuel beds) “generally have little commercial value and receive little management” (Broad 2003 in Miller 2012). Given the reduction in

woodland management it is likely that mature and deadwood habitats would have increased and potentially had a subsequent positive effect on species dependent on deadwood microhabitats.

With respect to air quality Rowe and others (2020) report that the area of managed broadleaved woodland exceeding acidity critical loads reduced by 29.2% between 1996 and 2017 whilst the area of unmanaged woodland exceeding acidity critical loads reduced by 41% over the same period.

**Other sources:** BRIG 2011; Southall and others 2003; UK Biodiversity Group 1998.

**Confidence**: Low

## 3.3 Future maintenance of biological diversity and variation in the habitat

The key threats and pressures affecting Annex I wet woodlands within England, identified within the Fourth Report by the United Kingdom under Article 17 (JNCC 2019) were:

- Hydrological – lack of water (for example through abstraction, drainage); adverse water-flow management within the hydrological zone of influence of the habitat; changes in water flow to or within the habitat (for example, over or under flooding, resulting from canalisation, water flow control, hydropower, weirs).
- Hydrological - poor water quality; ground water pollution (diffuse or point source).
- Plant and animal diseases, pathogens and pests.
- Air pollution.

Being largely dependent on specific hydrological conditions, the greatest risk to wet woodlands is anthropogenic changes to the natural hydrology. Achieving more natural hydrological functioning is likely to be critical in reaching Favourable Conservation Status (FCS) (Wetherell and others 2015). Hydrological restoration can contribute to long-term sustainability, for example, with regards to climate change adaptation. It can also reduce other stressors in the landscape such as the impacts of air pollution, water pollution and habitat fragmentation. An approach that focuses on natural hydrological processes, embedding wet woodland within large–scale wetland habitat complexes, could therefore provide the most sustainable approach to restoration in the long-term. Naturally functioning freshwater habitat, free of artificial modifications, caters appropriately to its characteristic biological assemblages and individual species. However, Wetherell and others (2015) noted that it is difficult to recognise sites and features with modified or sub-optimal hydrological regimes, and to identify the related impacts on the biological features. This can lead to the under-reporting of hydrological issues and a tendency to classify modified hydrology as the favourable situation. Habitats such as wet woodland often have significant hydrological modification, particularly drainage and ditching.

The Climate Change Adaptation Manual (NE & RSPB 2019) concludes that wet woodland is of medium sensitivity to climate change. Read and others (2009) cite various sources to

suggest that effects on wet woodlands will be dictated locally rather than regionally as a result of changes in climate. They suggest that some threats, such as increased summer drought in England, may be countered by wetter winters but species composition may alter from alder to ash. As an ecosystem component in the landscape, there are likely to be declines and increases in wet woodland in different catchments or areas. Climate change is likely to result in changes in habitat composition depending on how individual species (both flora and fauna) respond. There may be local or regional shifts along the hydrological spectrum of the habitat depending on catchment changes in flood and precipitation patterns. Increased flooding may create opportunities for natural cycles within catchments, such as regeneration and raising the water table. Increases in tree foliar and bacteria pests are likely which may also impact dependent invertebrates. Some deadwood-dependent species may increase in the medium term before potentially decreasing if the host species is lost from the habitat altogether. Improving connectivity and reducing fragmentation, for example, through enlarging existing sites, would help buffer the effects of climate change.

Outbreaks of disease, such as *Phytophthora* root disease and ash die back, will have impacts on habitat quality through having the potential to alter the structure and species composition and in extreme cases area and distribution.

## Natural range and distribution

The current range and distribution, considered as hectads, is unlikely to change but there may be localised shifts in response to any changes in hydrological regime resulting from climate change. The exact changes remain uncertain given the unknown precise climate change scenario. The current distribution should be maintained as a minimum taking account of:

- natural fluctuations associated with natural river system dynamics for riverine woodlands.
- distribution of bog woodland should be considered in conjunction with associated bog habitats given both have conservation interests and priorities.

**Confidence**: Low

## Extent

Expansion would be desirable to redress historical losses and support threatened species. Providing larger wet woodlands would reduce likelihood of local extinctions as the woodland habitat would be able to support more frequent micro-habitats. There is limited evidence to determine how much wet woodland is necessary to ensure that the biological diversity associated with the habitat thrives in the future. However, the literature generally concurs that an increase in area and reduction of fragmentation is necessary by, for example, buffering existing habitats, where conditions are appropriate, or new woodland creation.

Expansion might be sought as follows:

- Securing and enlarging existing wet woodlands:
    - Doubling the size of woodlands that are under 5 ha in extent to reduce risk of future loss and allow for an increase in the populations present. Assuming a mean size of additional woodland of 2.5 ha, then the total area of new woodland is 27,000 ha.
    - Putting a 20 m buffer around woodlands between 6 and 20 ha in extent would help reduce impacts of spray drift, drying out etc as well as adding to habitat area and heterogeneity. Based on a circular 10 ha wood, this would require about 6,000 ha additional habitat.
- Improving the landscape matrix and creating new woodland blocks
    - Allocate 10,000 ha (about 250 ha per county) for creation of small woodlands to provide connections and stepping-stones in woodland landscapes.
    - Allocate 10,000 ha to create 5 large (50 ha) new blocks per county (amalgamating small counties there are about 40 in England).

This would give an additional 53,000 ha of wet woodland.

No increase in the extent of H91D0 Bog woodland is proposed for favourable status as this habitat is not considered to be a feature of naturally functioning ecosystems in England.

An increase in the extent of H91E0 Alluvial forests proportional to the increase in extent of wet woodlands is proposed. This would give an area of 3,000 ha in total.

**Confidence:** Low

## Patch size and connectivity

Given the small patch sizes - considered in many cases to be too small to be self-sustaining – there must be no reduction of patch size: current patch sizes should be at least maintained.

It is generally accepted that wet woodlands were once much larger, especially those in floodplains, therefore, current patches should be increased in size. However, there is no evidence to indicate an appropriate and viable patch size to ensure the habitat thrives in the future. It has been suggested for woodlands generally (that is, not specifically wet woodlands) that between 3 ha and 30 ha is necessary to allow a woodland to contain the permanent and temporary open space required to support structural, age class and species diversity (Peterken 2002) with the lower end only really being viable when the woodland is appropriately managed. But, if there is good connectivity, viable patch sizes could potentially be smaller as micro-habitats essential for species could, in some situations, be provided by associated and nearby habitats such as fens, reedbed, mesic woodland, scrub etc. Therefore, for favourable status, patches should be sufficiently large

to function naturally within the hydrological and topographical constraints and size will be determined by local environmental conditions.

**Confidence:** Low

### Quality of habitat patches

There is a consensus across the nature conservation sector that natural ecosystem function, based on natural environmental processes, is the best and most sustainable expression of freshwater and wetland habitats and their characteristic wildlife. Therefore, restoration of natural function is essential for the future of wet woodland and to achieve favourable conservation status. However, as Wheeler and others (1999) have reported wet woodlands have, at least historically, been subject to human interventions be that direct (coppicing) or indirect (drainage of adjacent lands). Therefore, it may be difficult to determine what is the 'natural' character of the habitats, especially, as noted by Wheeler and others (1999), "as the actual degree of modification of extant wet woodlands is often neither known nor obvious."

**Confidence:** Moderate

### Threatened species

Willow tit has territories up to 5 ha (YWT & RSPB) although this does not need to be solely wet woodland nor in a single block. It is fairly sedentary; the IUCN (2019) suggest it rarely disperses more than 5 km. Increasing wet woodland habitat and improving connectivity with blocks within 5 km of other blocks (or other suitable willow tit habitat) would benefit this species.

Bechstein's bat requires suitable woodland of 25–50 ha (or more) (BCT 2010) or well-connected smaller woodlands in close proximity, for example 1 km. Increasing wet woodland habitat and improving connectivity with blocks within 1-3 km of other blocks (or other mature woodland types) would benefit this species where it currently occurs. Mature trees will also be important to provide roosting opportunity.

Invertebrates: There is some information in the literature (for example, Bowe and others 2019; Ray and others 2004) that has documented dispersal ranges for at least some species associated with wet woodland. The dispersal range for some of the more wetland specialist craneflies and soldierflies was just 250 m. Without larger patch sizes and/or adequate connectivity populations associated with small woodland patches would be at risk of isolation and extinction.

**Confidence**: Low

## 3.4 Constraints to expansion or restoration

Wet woodlands can only be established where the specific hydrological, edaphic and topographic requirements are present or can be restored.

It will not be possible to restore wet woodland to areas that have been lost to urban development or where the conditions have been destroyed beyond the point of reversal, for example where peat has been entirely lost. However, the extent of wet woodland lost to these causes is not known.

The constituent tree species of wet woodland – willow, alder and birch – easily regenerate naturally given the appropriate ground conditions. The principles of wet woodland hydrology are known and knowledge gaps identified to allow for restoration and creation, for example, Barsoum and others (2005); Mainstone and others (2016).

Existing wet woodland that is currently in a poor condition can be improved and it is technically feasible to reverse or at least control the threats. Success and degree of improvement will depend on the underlying cause. Some causes of poor condition can readily be rectified through changes in management, for example:

- Re-wetting via re-engineering of historic drainage infrastructure which slows the flow and retains water on site to recharge the local groundwater.
- Removal of grazing.
- Removal of non-native and invasive species.
- Creation of opportunities, such as gaps or bare ground, to allow natural regeneration to take place.
- Implement management, such as coppicing or layering, to encourage the development of a shrub layer/secondary canopy.

Expansion and restoration of wet woodland through restoration of natural ecosystem function, based on natural environmental processes, will bring benefits to related wetland habitats and associated wetland species. Restoration of natural ecosystem function may encourage a more dynamic transition between wet woodland and other wetland habitats which may be beneficial for some species associated with these habitats.

However, some of the recent expansion of wet woodland has been caused by a lack of management of fen and reedbed, leading to a loss of those habitats and their associated species. The further expansion of wet woodland into these habitats may cause additional loss of high-value, open wetland habitats unless carefully planned and subsequently managed as part of a diverse mosaic of successional wetland habitat. Creation of wet woodland, as other woodland, has the potential to impact on populations of species associated with open habitats, including many which are threatened in their own right. Careful planning is critical to avoid further threat to populations of such species.

Restoration of the natural hydrological function may lead to a loss of drier woodland types through the restoration of wet woodland on drained woodland sites.

Creation and restoration of wet woodland will benefit beaver populations, as this formerly native species returns to England’s river catchments. Beavers are likely to play an

increasingly important role in maintaining dynamic habitat functioning and contributing to the re-wetting of woodland.

**Confidence:** Low-Moderate

# 4. Conclusions

## 4.1 Favourable range and distribution

The favourable range and distribution is the current range and distribution – 706 hectads.

## 4.2 Favourable extent

131,000 ha

## 4.3 Favourable structure and function attributes

### Structure attributes

#### Deadwood and leaf litter

For favourable status a variety of standing and fallen deadwood and leaf litter should be present throughout including standing and fallen dead trees, debris dams, saturated deadwood associated with wet features.

#### Vertical age structure

A diverse woodland structure, including the following:

- Trees and shrubs of different ages.
- Several vegetation layers.
- <10-25% young growth (dense thicket stands).
- Some old and veteran trees present. Minimum ten mature trees per hectare in single or connected patches.

Regeneration potential: Sufficient natural regeneration to maintain, for example, young trees and saplings in gaps.

#### Spatial variation

There should be permanent and temporary open space present (20% canopy cover) and areas of open or transitional wooded habitats (20-70% canopy cover) plus areas of closed canopy with high humidity (>70% canopy cover).

#### Associated habitats

Wet woodland should form a mosaic with other associated habitats appropriate to the geographic, hydrological and/or topographic situation.

Presence of natural transitions to, and mosaics with, other habitats reflecting natural variations in abiotic conditions.

### Hydrological and soil micro-features

Seepages, surface water and standing water present as appropriate to a naturally functioning situation.

### Vegetation composition (native, non-native, invasive species)

- At least 95% appropriate native species.
- Attributable to an appropriate NVC community taking account of geographic location and hydrological or topographic situation.
- Non-native or inappropriate native species should contribute to no more than 5% in any one layer.
- No, or low levels, of invasive non-native species.

### Pests and diseases

- Low levels of pests and diseases.
- No signs of rapid dieback for example through disease (less than 10% cover in a five-year period) of tree and shrub layer.
- Less than 5% dead trees attributed to disease.

## Function attributes

### Hydrological functioning

- Natural hydrological function, water chemistry and water nutrient status.
- No artificial drainage features such as ditches, channel canalisation, inappropriate clearance.
- Low or no artificial drainage impact in the catchment

### Soil characteristics

Natural soil characteristics, determined by local environmental conditions.

### Air quality

Concentrations and deposition of air pollutants are at levels that enable the ecosystem to function naturally, at or below the relevant Critical Load or Level values. The natural biota reflect the natural background air quality.

### Vegetation management

- Favourable structure maintained.

- No clear browse line.
- No excessive soil damage, extent of bare ground to reflect local environmental conditions.

## Patch size and connectivity

Patches should be sufficiently large to function naturally within the hydrological and topographical constraints and size will be determined by local environmental conditions.

At least 80% of wet woodland should be within woodland patches at least 30 ha in size, located in an area with semi-natural surroundings as opposed to being surrounded by intensive farmland. Therefore, part of a habitat network

Based on the requirements of notable associated species, for example willow tit and Bechstein's bat, woodland patches should be within 5 km in core areas or 3 km of other mature woodland habitats. Connection can be via hedgerows, tree lined watercourses, wetlands and meadows.

## Quality of habitat patches

At least 95% of the favourable area of the habitat meets the structure and function requirements as described above.

## Threatened species

All species partially or wholly dependent on this habitat should be Least Concern, when assessed using IUCN criteria (or considered to be Least Concern if not formally assessed), as regards to this habitat.

# References


BARSOUM, N., ANDERSON, R., BROADMEADOW, S., BISHOP, H., NISBET, T. 2005. *Eco-hydrological guidelines for wet woodland - Phase 1.* English Nature Research Report 619. Peterborough: English Nature.

BAT CONSERVATION TRUST. 2010. *Bechstein's bat.* https://cdn.bats.org.uk/pdf/About%20Bats/bechsteins_11.02.13.pdf?mtime=20181101151256. Accessed 25/11/2019. Bat Conservation Trust.

BOWE, M., HIGGINSON, E., CHANT, J., OSBOURNE, M. 2019. *Somerset's Ecological Network: Mapping the components of the ecological network in Somerset.* Somerset Wildlife Trust. http://www.somerc.com/wp-content/uploads/2019/08/Somerset-Ecological-Networks-Report-2019.pdf Accessed 29/11/2019.

BOYCE, D.C. 2002. *A review of seepage invertebrates in England.* Report 452. Peterborough: English Nature.

BRIG (ed. Maddock, A). 2011. *UK Biodiversity Action Plan Priority Habitat Descriptions.* https://webarchive.nationalarchives.gov.uk/20140714115815/http://jncc.defra.gov.uk/PDF/UKBAP_PriorityHabitatDesc-Rev2011.pdf. Accessed 11/10/2019.

DITCHBURN, B., BELLAMY, C., WILSON, T., STEEL, P., HENDERSON, L., KIRBY, K. 2020. *NFI woodland ecological condition in Great Britain: Methodology*. Forestry Commission National Forest Inventory, Edinburgh.

DYSON, C. 2020. Alluvial floodplain woodland with Black Poplar: a lost habitat. *British Wildlife.* 32 (2), 89-95.

ENVIRONMENT AGENCY. 2009. *Achieving more: operational flood storage areas and biodiversity.* Environment Agency. https://www.therrc.co.uk/MOT/References/EA_Achieving_more_Operational_flood_storage_areas.pdf

ENVIRONMENT AGENCY & NATURAL ENGLAND. 2021. *State of the water environment indicator B3: supporting evidence.* *https://www.gov.uk/government/publications/state-of-the-water-environment-indicator-b3-supporting-evidence/state-of-the-water-environment-indicator-b3-supporting-evidence#surface-waters-ecological-and-chemical-classification* Accessed 24/12/2021. Environment Agency & Natural England.

EUROPEAN ENVIRONMENT AGENCY (EEA). 2019a. *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae).* https://eunis.eea.europa.eu/habitats/10198. Accessed 07/11/2019. European Environment Agency.

EUROPEAN ENVIRONMENT AGENCY (EEA). 2019b. *Bog woodland.* https://eunis.eea.europa.eu/habitats/10197. Accessed 07/11/2019. European Environment Agency.

ENTWISTLE, N.S., HERITAGE, G.L., SCHOFIELD, L.A., WILLIAMSON, R.J. 2019. Recent changes to floodplain character and functionality in England. *Catena,* 174, 490-498. https://doi.org/10.1016/j.catena.2018.11.018

EUROPEAN COMMISSION. 2013. *Interpretation manual of European Union habitats.* https://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf. Accessed 11/10/2019.

FARROW, S. & WRIGHT, D.F. 2000. *Lincolnshire Biodiversity Action Plan Habitat Action Plans Species Action Plans.* Lincolnshire Wildlife Trust. https://glnp.org.uk/admin/resources/lincolnshire-bap-1st-edition-2000.pdf

FOREST RESEARCH. 2019. *Phytophthora disease of alder.* Forest Research.

IUCN. 2019. *Willow tit.* The IUCN Red List of Threatened Species. Version 2019-2. https://www.iucnredlist.org/species/22711703/60219721#habitat-ecology Accessed 25/11/2019

JANSSEN, J.A.M., J.S. RODWELL, M. GARCÍA CRIADO, S. GUBBAY, T. HAYNES, A. NIETO, N. SANDERS, F. LANDUCCI, J. LOIDI, A. SSYMANK, T. TAHVANAINEN, M. VALDERRABANO, A. ACOSTA, M. ARONSSON, G. ARTS, F. ATTORRE, E. BERGMEIER, R.-J. BIJLSMA, F. BIORET, C. BIŢĂ- NICOLAE, I. BIURRUN, M. CALIX, J. CAPELO, A. ČARNI, M. CHYTRÝ, J. DENGLER, P. DIMOPOULOS, F. ESSL, H. GARDFJELL, D. GIGANTE, G. GIUSSO DEL GALDO, M. HÁJEK, F. JANSEN, J. JANSEN, J. KAPFER, A. MICKOLAJCZAK, J.A. MOLINA, Z. MOLNÁR, D. PATERNOSTER, A. PIERNIK, B. POULIN, B. RENAUX, J.H.J. SCHAMINÉE, K. ŠUMBEROVÁ, H. TOIVONEN, T. TONTERI, I. TSIRIPIDIS, R. TZONEV & M. VALACHOVIČ. 2016. *European Red List of Habitats. Part 2: Terrestrial and freshwater habitats*. European Commission, Brussels. https://ec.europa.eu/environment/nature/knowledge/pdf/terrestrial_EU_red_list_report.pdf

JOINT NATURE CONSERVATION COMMITTEE. 2007. *Second Report by the United Kingdom under Article 17on the implementation of the Directive from January 2001 to December 2006*. Peterborough: JNCC.

JOINT NATURE CONSERVATION COMMITTEE. 2013. *Third Report by the United Kingdom under Article 17on the implementation of the Directive from January 2007to December 2012*. Peterborough: JNCC.

JOINT NATURE CONSERVATION COMMITTEE. 2019. *Fourth Report by the United Kingdom under Article 17on the implementation of the Directive from January 2013 to December 2018*. Peterborough: JNCC.

KERR, G. & NISBET, T.R. 1996. *The restoration of floodplain woodlands in lowland Britain.* R&D Technical Report W15. Bristol: Environment Agency.

LUC. 2009. *Review of the extent and condition of Biodiversity Action Plan Habitats in the East of England*. Land Use Consultants. http://www.eoebiodiversity.org/reports/luc%20biodiversity%20condition%20report%20(march%2709).pdf

MACKIN, F., BARR, A., RATH, P., EAKIN, M., RYAN, J., JEFFREY, R. & FERNANDEZ VALVERDE, F. 2017. Best practice in raised bog restoration in Ireland. *Irish Wildlife Manuals, 99.* National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

MAINSTONE, C., HALL, R. & DIACK, I. 2016. *A narrative for conserving freshwater and wetland habitats in England.* Natural England Research Reports, Number 064. Peterborough: Natural England.

MAINSTONE, C.P., JEFFERSON, R., DIACK, I, ALONSO, I, CROWLE, A., REES, S., GOLDBERG, E., WEBB, J., DREWITT, A., TAYLOR, I., COX, J., EDGAR, P. & WALSH, K. 2018. *Generating more integrated biodiversity objectives – rationale, principles and practice.* Natural England Research Reports, Number 071. Peterborough: Natural England.

MILLER, H.S. 2012. *Plant ecology of lowland Alnus glutinosa woodlands: the management implications of species composition, requirements and distribution.* Unpublished PhD Thesis. Aston University.

MILLER, H.S. 2020. *Wet woodland: key messages from evidence*. Internal document to Natural England.

MOSS, C.E., RANKIN, W.M. & TANSLEY, A.G. 1910. The Woodlands of England. *The New Phytologist,* 9.3/4, 113-149.

MOUSLEY, S & VAN VLIET, W. 2021. Defining favourable conservation status in England: Natural England approach. Natural England Evidence Information Note EIN062. Natural England, York.

NATURAL ENGLAND. 2008. *State of the Natural Environment 2008, Chapter 3: Biodiversity.* http://publications.naturalengland.org.uk/publication/31043. Accessed 31/12/2019.

NATURAL ENGLAND. 2019. *SSSI Condition Assessment database.* Natural England, York.

NATURAL ENGLAND AND RSPB. 2019. *Climate Change Adaptation Manual - Evidence to support nature conservation in a changing climate, 2nd Edition*. Natural England, York.

NERC. 2008. *Countryside survey: UK results from 2007.* Natural Environment Research Council.

PANTER, C., MOSSMAN, H., DOLMAN, P.M. 2011. *Biodiversity Audit and Tolerance Sensitivity Mapping for the Broads.* Broads Authority Report. Norwich: School of Environmental Sciences, University of East Anglia. https://www.broads-authority.gov.uk/__data/assets/pdf_file/0020/412922/Broads-Biodiversity_audit_report.pdf

PETERKEN, G.F. 1977. Habitat conservation priorities in British and European woodlands. *Biological Conservation*, 11, 223-236.

PETERKEN, G.F. 2002. *Native woodland development in the North York Moors and Howardian Hills.* Pickering: Forestry Commission.

PETERKEN, G.F. & HUGHES, F.M.R. 1995. Restoration of floodplain forests in Britain. *Forestry: An International Journal of Forest Research*, 68, 3, 187–202.

QUINE, C., CAHALAN, A., HESTER, A., HUMPHREY, J., KIRBY, K., MOFFAT, A. & VALATINE, G. 2011. *Woodlands. In: The UK National Ecosystem Assessment Technical Report*. UK National Ecosystem Assessment. Cambridge: NEP-WCMC.

RACKHAM, O. 2003. *Ancient woodland its history, vegetation and uses in England.* Colvend: Castlepoint Press.

RAY, D., HOPE, J., WATTS, K. 2004. *Development of a forest habitat network strategy in West Lothian*. Contract no ab(lj15)0304118. Forest Research.

READ, D.J., FREER-SMITH, P.H., MORISON, J.I.L., HANLEY, N., WEST, C.C. & SNOWDON, P. (eds). 2009. *Combating climate change – a role for UK forests. An assessment of the potential of the UK's trees and woodlands to mitigate and adapt to climate change*. Edinburgh: The Stationery Office.

ROBINSON, M. 1986. The Extent of Farm Underdrainage in England and Wales, prior to 1939. *The Agricultural History Review*, 34, 79-85.

ROBINSON, M & GIBSON, H. 2011. *Assessing the Status of Drainage in the UK: A Case Study of the Avon, Eden and Wensum DTCs and their representativeness with regional and national patterns.* Wallingford: Centre for Ecology and Hydrology. http://nora.nerc.ac.uk/id/eprint/14118/1/ADAS-Defra_Drainage_in_DTCs.pdf

ROWE, E.C., MITCHELL, Z., TOMLINSON, S., LEVY, P., BANIN, L.F., SAWICKA, K., MARTÍN HERNANDEZ, C. & DORE, A. 2020. *Trends Report 2020: Trends in critical load and critical level exceedances in the UK.* Report to Defra under Contract AQ0843, CEH Project NEC05708. https://uk-air.defra.gov.uk/library/reports?report_id=100

RSPB & EA. 2016. *Water for farmers and wildlife.* https://www.rspb.org.uk/globalassets/downloads/documents/futurescapes/water-for-farmers-and-wildlife.pdf. Accessed 25/11/2019. RSPB & Environment Agency.

RYEDALE DISTRICT COUNCIL. 2007. *Ryedale Biodiversity Action Plan 2007-2012.* https://www.ryedale.gov.uk/attachments/article/315/RYEDALE_BAP_2007.pdf

SANDERSON, N. 2008. *Status of rare woodland plants and lichens*. https://plantlife.love-wildflowers.org.uk/uploads/documents/Sanderson_woodland_report_FINAL.pdf

SOUTHALL, F. J., DALE, M.P. & KENT, M. 2003. Floristic variation and willow carr development within a southwest England wetland. *Applied Vegetation Science,* 6, 63-72.

UK BIODIVERSITY GROUP. 1998. *Tranche 2 Action Plans Terrestrial and Freshwater Habitats.* http://archive.jncc.gov.uk/PDF/UKBAP_Tranche2-ActionPlans-Vol2-1998.pdf. Accessed 28/11/2019.

WEBB, J., HEAVER, D., LOTT, D., DEAN, H.J., VAN BREDA, J., CURSON, J., HARVEY, M.C., GURNEY, M., ROY, D.B., VAN BREDA, A., DRAKE, M., ALEXANDER, K.N.A. & FOSTER, G. 2018. Pantheon - database version 3.7.6. https://www.brc.ac.uk/pantheon/

WETHERELL, A. MAINSTONE, C., DIACK, I., CATHCART, R. & VAN VLIET, W. 2015. *Hydrological functioning theme plan: Restoring the hydrology of Natura 2000 terrestrial wetlands*. Improvement Programme for England's Natura 2000 Sites – Planning for the Future'. Peterborough: Natural England.

WHEELER, B.D., SHAW, S.C. & EADES, P.A. 1999. *The Biodiversity Value of Wet Woodlands in Comparison to Open Herbaceous Wetlands.* Countryside Council for Wales. Report 336.

WHEELER, B.D., SHAW, S.C. & LATHAM, J. 2001. *Ecological relationships of wet woodlands, fens and associated wetland habitats in Wales.* Countryside Council for Wales. Report 446.

WHITEMAN, M., BROOKS, A., SKINNER, A. & HULME, P. 2010. Determining significant damage to groundwater-dependent terrestrial ecosystems in England and Wales for use in implementation of the Water Framework Directive. *Ecological Engineering*, 36, 1118–1125.

WOLTON, R.J., CHANDLER, P.J., DRAKE, C.M. & STUBBS, A.E. 2017. The relative importance of wet woodland and wet grassland for Diptera conservation: a case study from Devon, England. *Dipterists Digest,* 24, 79-94.

YWT & RSPB. 2019. *Back from the Brink: Willow Tit.* Yorkshire Wildlife Trust & RSPB. https://naturebftb.co.uk/the-projects/willow-tit/ Accessed 25/11/2019.

# Appendix 1: Woodland diversity within the UK (adapted and expanded from Miller 2012)

| Classification/categorisation | Number of woodland types | | Number of wet woodland sub-types | | | |
|---|---|---|---|---|---|---|
| | All woodland | Wet woodland | Alder | Birch | Willow | Other, for example ash, oak |
| **Tansley (Tansley 1965)** | 9 | 4 | 3 | (Scotland only) | N/A | 1 (oak) |
| **Merlewood National Classification of British Woodland (Bunce 1982)** | 32 | 9 | 6 | 1 | 1 | 1 (oak) |
| **Peterken Stand Type Classification (Peterken 1993)** | 39 Stand Types with 38 sub-types | 3 Groups within which are 8 Stand Types within which are 12 sub-types | 7 sub-types within 4 Stand Types (1 occurs in Scotland only so excluded) | N/A | N/A | 5 sub-types within 3 Stand Types (ash/elm/maple) |
| **National Vegetation Classification (Rodwell 1991)** | 59 sub-communities within 19 communities | 18 sub-communities within 7 communities | 11 sub-communities within 3 communities | 3 sub-communities within 1 community | 4 sub-communities within 3 communities | 2 sub-communities within 1 community (ash) |

| Classification/categorisation | Number of woodland types | | Number of wet woodland sub-types | | | |
|---|---|---|---|---|---|---|
| | All woodland | Wet woodland | Alder | Birch | Willow | Other, for example ash, oak |
| | | | | (although are towards the mesic woodland) | | |
| **Rackham (Rackham 2003)** | 31 | 5 | 3 | N/A | N/A | 2 (aspen/ash) |
| **Countryside Vegetation System (Bunce and others 1999)** | 15 | 6 | 3 | 2 | N/A | 1 (ash) |

# Appendix 2: Location of wet woodland (from Miller 2012 with additional sources: Rodwell 1991; European Commission 2013; Averis and others 2014; Barsoum and others 2005)

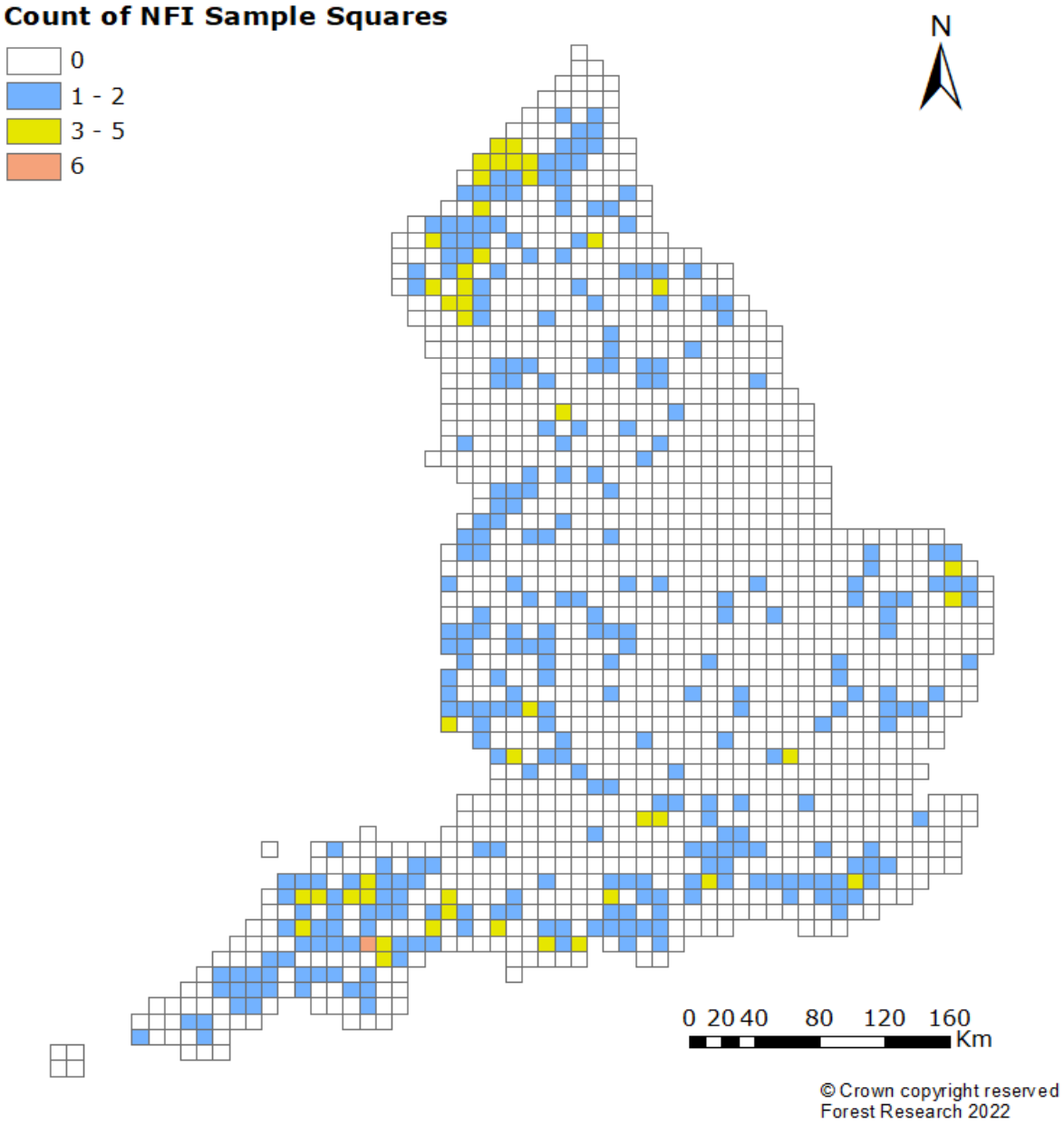
Any cells left blank in this table indicate that the species is not relevant to the tertiary character.

| Character | Secondary character | Tertiary character | H91E0 | H91D0 | W1 | W2 | W3 | W4c | W5 | W6 | W7 | W8b | W8c |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Geographic | Upland | | Yes | | | Yes | Fringe | | | Fringe | Fringe | Fringe |
| | | Lowland | | Yes | Yes | Yes | | Yes | Yes | Yes | Yes | Yes | Yes |
| | Topography | Plateau/terraces | | | | | | | Yes | | Yes | Yes | |
| | | Valley | | | | Mire | | Bottom | Mire | River | River | | |
| | | Adjacent watercourse | Yes | | Yes | | | | Yes | Yes | Yes | | |

| Character | Secondary character | Tertiary character | H91E0 | H91D0 | W1 | W2 | W3 | W4c | W5 | W6 | W7 | W8b | W8c |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Adjacent standing water | | | Yes | | | | Yes | Yes | | | |
| | | Mires | | | | | Yes | Yes | Yes | Yes | | | |
| | | Floodplain mire | | | (Less often) | Yes | | Yes | Yes | Yes | | | |
| | | Floodplain - uncultivated | Yes | | | | | | | Yes | | | |
| | | Basin mire | | | (Less often) | Yes | Yes | Yes | Yes | | | | |
| | | Fens | | | | Yes | | Yes | | Yes | | | |

# Appendix 3: Distribution of wet woodland as shown by National Forest Inventory sample squares

A map showing the distibution of NFI sample squares where the priority habitat 'Wet Woodland' has been identified. A total of 352 hectads in England contain records of Wet Woodland.



## About Natural England

Natural England is here to secure a healthy natural environment for people to enjoy, where wildlife is protected and England's traditional landscapes are safeguarded for future generations.

## Further Information

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