Tree Planting Guide for Cornwall

European Union
European Regional Development Fund

Tevi

Growing Your Business,
Growing Our Environment.

HM Government

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Tevi's Tree Planting Guide for Cornwall

The aim of Tevi's Tree Planting Guide for Cornwall is to bring stakeholders together to identify, design and bring into fruition local solutions to global sustainability challenges. By fostering collaboration between academics, external experts, and enterprises we aim to collectively tackle the issues that are too big for any one organisation to take on alone.

Tevi's Canopy Cover Challenge Network aims to support the Forest for Cornwall initiative, which is an ambitious tree planting project to increase canopy cover by 8,000 hectares across the county. This project will establish approximately 12 million trees and will increase tree cover in the county from 9% to around 12% of Cornwall's land. The Forest for Cornwall aims to get the right tree, in the right place, for the right purpose.
Ensuring the successful delivery of this initiative requires residents, landowners, foresters, arborists, nurseries, gardeners, and conservationists to work together to ensure that the correct trees are planted in the right place and managed correctly. While this sounds simple, many considerations and potential pitfalls were identified by Challenge Network participants over the course of this Network's meetings between July 2019 and February 2020.

The aim of this report is to collate the learnings of the Network, while adding to it the expertise and voices of other experienced stakeholders and organisations. We hope this report will become an information repository to guide tree planting and management projects, while also ensuring that the knowledge held by people working with trees across the region is captured.

University of Exeter

Cornwall Wildlife Trust

Cornwall Council
one and all • onen hag oll

Cornwall Development Company

State of the nation

Canopy cover in the UK is significantly lower than in Europe. Just 13% of the UK's total land area is woodland or tree plantations compared to 45% in Europe (Europe & Unece 2015). Looking more closely at the percentage of land that is wooded in the UK, there are substantial variations between regions; 10% in England, 15% in Wales, 19% in Scotland and 9% in Northern Ireland (Figure 1; Provisional woodland statistics 2020).
In addition to the 10% woodland cover in England it is estimated that an additional 4% of land is covered by trees in residential areas through urban planting, managed hedgerow and private gardens (Forestry Commission 2017). In fact, approximately 89 million trees are found within urban landscapes (National Forest Inventory 2011).

There is a roughly even split of coniferous and broad-leaved woodland in the UK. Approximately half of the coniferous woodland is privately owned, with the majority (92%) of broad-leaved woodland under private ownership. Around 27% of woodland is publicly owned (Woodland natural capital accounts, UK, 2020).

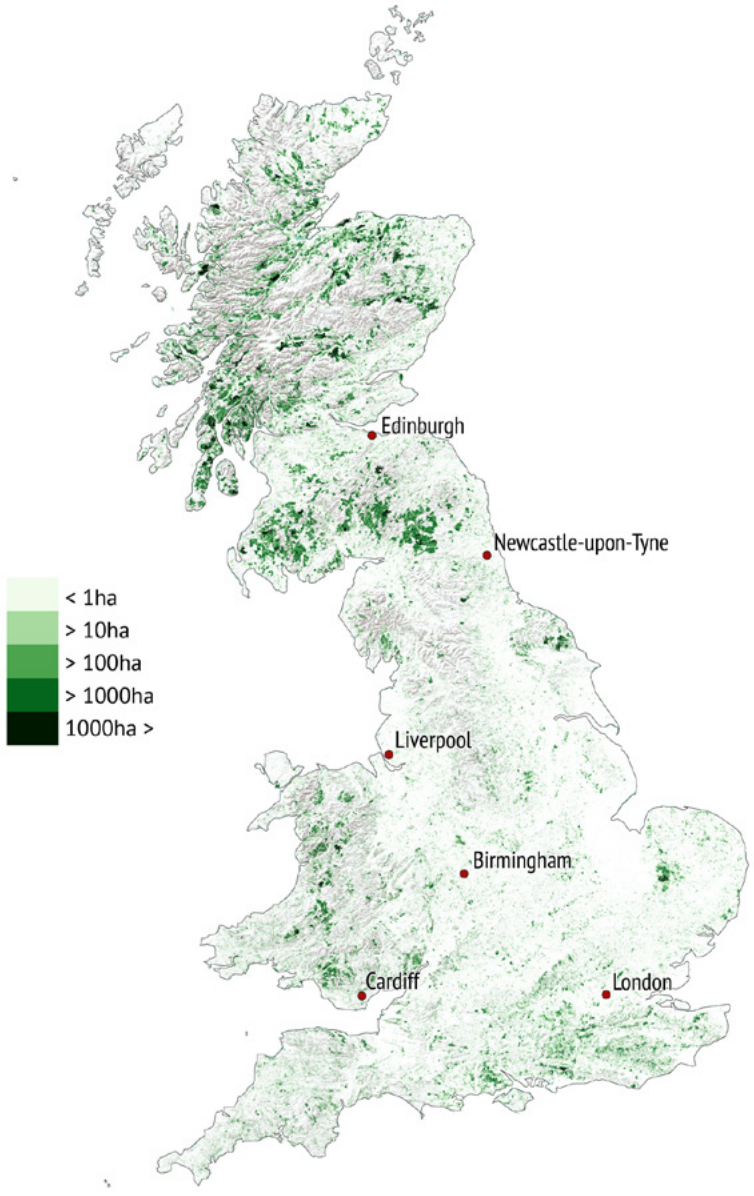

Figure 1. Woodland cover in Great Britain in 2018. Woodland is a minimum area of 0.5 hectares under stands of trees with, or with the potential to achieve, tree crown cover of more than 20% of the ground. Source: National Forest Inventory. Graphic taken from Carbon Brief (2020).

At the turn of the 20th century tree cover had fallen to around 5% of land cover in the UK due to industrial and agricultural pressures (Figure 2). The creation of the Forestry Commission in 1919 has led to a significant increase in tree cover over the past century, as did the large-scale planting projects in the 1970s and 1980s, which were fuelled by government tax breaks. To ensure a domestic timber supply the government provided tax incentives to coniferous afforestation projects through a system of tax benefits and grants to attract financial investment (Anderson 2010). These tree plantations were often of non-native species that provided economic benefits, as well as unplanned environmental harm such as the associated decline in peat bogs and drying of soils (Anderson 2010).

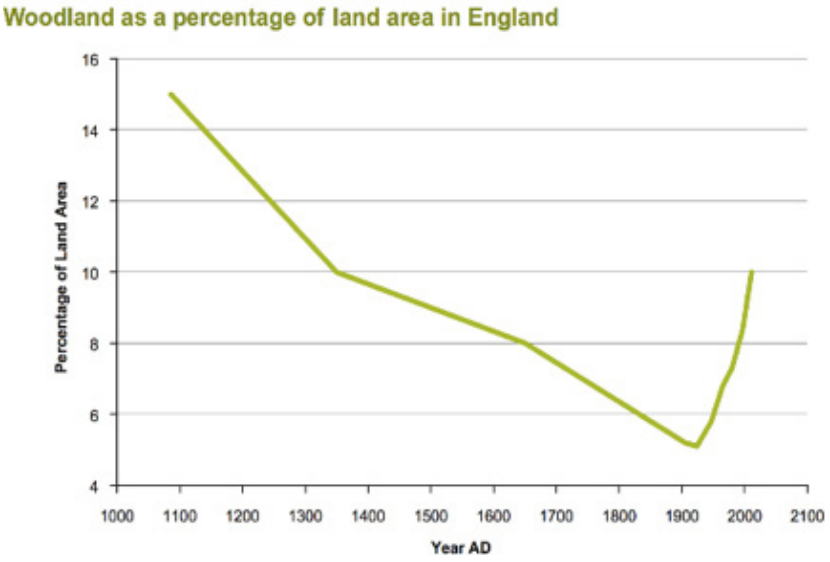

Figure 2. from Government Forestry and Woodland Policy statement (DEFRA 2013)

Since 1947 woodland cover has increased by 73% across England despite a slowing down of planting activity in recent decades, See figure 3 (Provisional woodland statistics 2020). Renewed interest in emphasis is leading to an new upward trajectory with 13,000 hectares of additional woodland (coniferous plantations and native woodland) being created in 2019-20, see Figure 3 (Provisional woodland statistics 2020). This increase has been the result of action by individuals, conservation organisations and the Government. Indeed, in the last five years the Government has rallied behind tree planting as one of the key strands within the UK's environmental policies.

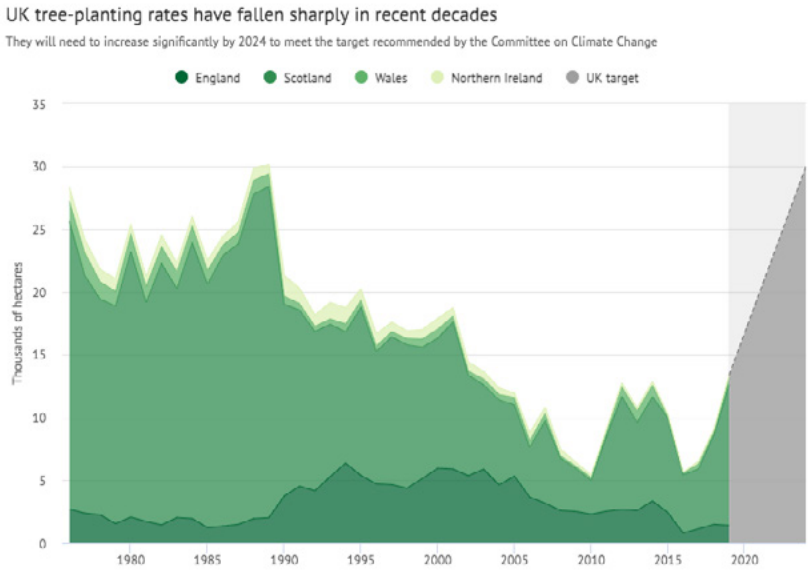

Figure 3. Tree planting in the UK nations from 1976-2019. Source: Forestry Commission. Chart taken from Carbon Brief (2020) using Highcharts

UK policies, strategies and funding that promote tree planting

25 Year Environment Plan (2018)

A long term strategy to improve the UK's air and water quality, protect threatened plants, increase trees and wildlife, combat climate change, improve resource efficiency and engagement with nature. The plan sets out goals for improving the environment and increasing sustainability. The ambition for trees and woodland include increasing woodland to 12% cover by planting 11 million new trees.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf

Environment Bill (2020)

The Bill is a vehicle for achieving the goals identified in the 25 year Environment Plan by creating a new framework for environmental governance. The Environmental Bill aims to generate a more sustainable, resilient economy that enhances well-being and the environment. In terms of woodland and trees, the Bill identified the need for action to expand woodlands and introduced the commitment to plant 30,000 hectares of trees per year by 2025. There will also be a duty to local highway authorities to consult with local communities before removing trees, and forestry enforcement measures will be strengthened – increased fines for felling and a mandatory Restocking Order. The commitment to tree planting was reaffirmed with the bill –to plant 11 million rural trees and 1 million urban trees by 2022.

https://publications.parliament.uk/pa/bills/cbill/58-01/0009/20009.pdf

England Tree Strategy (2020)

Sets out policy priorities to deliver a tree planting programme focused on expanding, protecting, and improving woodlands. In the Government's March 2020 budget, the new £640 million Nature for Climate Fund was announced, some of which will be used to deliver the Government's tree planting commitments. At the time of writing the strategy was in consultation phase and is due for publication in late 2021.

https://consult.defra.gov.uk/forestry/england-tree-strategy/

Tree Health Resilience Strategy (2018)

Outlines plans to mitigate the risk of disease and pest threats to trees and woodland in the UK (DEFRA 2018). This strategy focuses on building resilience by delivering three outcomes: resistance, response and recovery, and adaptation. The strategy identifies four key environmental goals:

- Improve extent of trees, woodland, and forest.
- Increase connectivity of trees and forests with other habitats.
- Enhance the genetic diversity and structural diversity of the treescape.
- Encourage healthier trees, woodland, and forests.

https://consult.defra.gov.uk/forestry/england-tree-strategy/

Woodland Carbon Guarantee scheme (2019)

A £50 million project to encourage farmers and landowners to plant more trees to help tackle climate change. The scheme allows participants to receive payments for woodland creation and can sell Woodland Carbon Units to the government for next 35 years at a set price to promote investment in carbon sequestration.

https://www.woodlandcarboncode.org.uk/woodland-carbon-guarantee

Net Zero (2019)

The Committee on Climate Change established a target of net zero greenhouse gas emissions by the UK by 2050. This target puts clean growth at the centre of economic policy and references the important role trees play in meeting the target.

file:///C:/Users/alexd/Downloads/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf

Woodland Grant Scheme (WSG) (2020)

The Forestry Commission provides incentives for people to plant and manage woodlands on sites across the UK.

https://data.gov.uk/dataset/853e79ec-3873-4e83-a2c5-cd7005504838/woodland-grant-scheme-2-england

Woodland Carbon fund (WCF) (2015)

Landowners, land managers, local authorities and public bodies can apply to the Forestry Commission for financial support to plant large-scale productive woodland. The scheme provides capital funding for the creation of productive woodland for carbon sequestration, including the planting of trees and costs of protection items including tree guards, fencing, and gates. A one-off capital payment of £1,000 per hectare is available in year 5 following successful establishment. Additional funding is available to sites that fall within the WCF priority places map.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/691642/Woodland_Carbon_Fund_priority_places_map.pdf

Countryside Stewardship: Woodland Creation Grant (2018)

Provides funding to supply, plant, weed and protect young trees. Applicants creating new woodland will receive up to £6,800 per hectare (ha).

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/823699/Woodland_Creation_Manual_2018.pdf

The above listed UK Government strategies, alongside the efforts of conservation organisations, and the increase in public interest in woodland restoration puts the UK on track to increase woodland cover by planting 30,000 hectares per year across the UK by 2025. Looking beyond 2025, these commitments and strategies put the UK on a positive trajectory to achieve the target of increasing tree cover to 12%.

Ecosystem services provided by trees

Woodland and trees have been recognised as one of the most valuable terrestrial habitats in the UK in terms of the value of ecosystem services that they support (De Groot et al 2012). Currently tree planting is considered the only scalable "negative emissions" (otherwise known as 'carbon sequestration') strategy in the UK because most other natural solutions to climate change are in their infancy and not ready to be rolled out nationally (Gabbatiss 2020). Importantly, tree planting in the right place also provides a range of additional benefits including economic opportunities, wildlife conservation, flood management and human wellbeing.

Photo by: @Johnstocker

Climate change

Correctly sited trees can counter climate change, which is driven by increased carbon and other greenhouses gasses in the atmosphere, by:

Absorbing carbon:

Through photosynthesis and sequestering it to create large carbon sinks which are stored within soil and living biomass, as well as in deadwood and leaf litter (Forest Research 2020). UK trees and woodlands contain 150 million tonnes of carbon and remove around 4 million tonnes from the atmosphere every year. Increasing woodland cover by 33% would reduce greenhouse gas emissions by 10% in the UK by 2050 (The case for trees, 2020).

Locking in carbon:

UK woodland removed 18.1 million tonnes of CO2, equating to 4% of total UK greenhouse gas emissions, in 2017 – valued at £1.2 billion (Woodland natural capital accounts, UK: 2020) Every cubic metre of timber used saves around 2 tonnes of CO2 and increasing the use of timber in construction could lock in 10 million tonnes annually. This occurs because once a tree is felled, and the timber is used for building, the carbon remains locked in the wood. It should be noted that if the timber is burnt as firewood the carbon is released again. The value of the carbon dioxide locked up in UK woodlands is estimated to be worth £16,000 per hectare (The economic benefits of woodland, 2017)

Temperature regulation:

Urbanisation can create Urban Heat Islands (UHI) as the use of impervious surface increases surface runoff, reduces evapotranspiration and increases solar radiation absorption; subsequently heating the urban environment (Arnfield, 2003). Extensive research has shown that the presence of trees within urban landscapes can dampen the UHI effect and decrease temperatures via direct shading and evaporative cooling (Loughner et al 2012). For instance, urban woodlands cooled 11 city regions and saved £229.2 million in avoided air conditioning and increased labour productivity in 2018 (Woodland natural capital accounts, UK: 2020).

Extreme weather:

As anthropogenic impacts continue to change the Earth's climate, trees play an important role in reducing the impacts of extreme weather. For example, trees in the right place can reduce flooding and slow rainwater run-off, promote the infiltration of water into the soil, and delay the downstream passage of flood flows (Broadmeadow & Nisbet 2010).

It should be noted that incorrectly sited trees can have the opposite effect, and it is therefore essential that trees are only planted on suitable soils and in suitable locations. There is more guidance on this in section **'Corectly siting your woodland'**

Environmental health

Correctly sited trees sustain and improve the health of the natural environment by:

Increasing biodiversity:

Woodland habitat is the most biodiversity rich terrestrial habitat in the UK, meaning that it can support a vast range of diverse flora and fauna species (The Woodland Trust 2018). Woodland is a key habitat for many organisms through its provision of food and shelter, as well as its facilitation of biotic and abiotic species interactions. For example, 2000 invertebrate species can be supported by a single mature oak, which supports a healthy food chain for mammals, birds, and plants (Discover Wildlife, 2019). Safeguarding woods and their associated biodiversity for future generations has been valued at £1,848 per hectare, per year, for lowland broad-leaved native forest (The economic benefits of woodland, 2017).

Improving air quality:

Trees reduce airborne particulates and absorb nitrogen dioxide, ozone, and sulphur dioxide, thus improving air quality by removing pollutants by both deposition on its surfaces (foliage or bark) and by stomal uptake through leaves (Nowak 2002; Grote et al 2016). Trees also emit volatile organic compounds which can lead to the formation of ozone (Nowak 2002). One study in France found that trees removed 88 tonnes of pollutants from the atmosphere in a single year, particularly large particulate matter (Selmi et al 2016). In 2017 the UK saved £938 million in related health costs through the removal of airborne pollution by woodland (Woodland natural capital accounts, UK: 2020).

Improving water quality:

Tree roots act as natural filters to remove pollutants (Jackson & Boutle 2008) and roots also help to stabilise the soil, thus reducing erosion which contributes to increased soil particulates in water (Nisbet, Orr, & Broadmeadow 2008). Improved water quality due to woodland ecosystem services has been estimated to provide €489 in benefits for each hectare in a Danish study (The economic value of woodland, 2017).

Reducing flooding:

By increasing soil infiltration rates, intercepting rainfall, absorbing water and providing hydraulic roughness - surface drag for flood waters - trees significantly contribute towards reduced flood risks (Institute of Chartered Foresters, 2017). The potential value of managed woodland, in terms of flood risk reduction, in the upper Thames catchment alone is estimated to be £350-£500 per hectare, per year (The economic value of woodland, 2017).

Reducing noise pollution:

Trees can help to reduce noise transmission and quieten traffic (Dwyer et al 1992). One study found that the planting of a greenbelt along a highway in Bangladesh reduced noise levels by 17dB (Islam et al 2012).

Social benefits

The positive social impacts provided by trees are also significant and include contributing towards increased:

Fitness and health:

The presence of green spaces and woodland encourages people to exercise which leads to health benefits and the cleaner air reduces the risk of asthma (Lovasi et al 2008).

General health:

Air pollution is credited with contributing towards 29,000 deaths a year in the UK (Ayres 2010). Air pollution mitigation in urban areas by trees is estimated to be worth around £240 a year for each hectare of woodland (The economic value of woodland, 2017).

Mental wellbeing:

Spending time in woodland has been shown to help people relax and reduce stress, resulting in improved mental health and wellbeing (Kuo & Sullivan 2001). Trees have also been credited with lowering crime rates, with lower rates recorded in areas with green spaces (Kuo & Sullivan 2001).

Economic dividends:

By providing profitable by-products for community and commercial use, and reducing greenspace maintenance costs. The presence of trees also increases an areas retail and property value performance (The Case for Trees 2010).

Photo by: @v.ivash


Photo by: @lifeforstock

Economic potential of trees

While the environmental and social benefits of woodlands are well understood and appreciated, a better comprehension of woodland's economic potential is required if we are to achieve the reforestation needed to meet national targets, as well as mitigate the climate and ecological emergency.

Well managed woodlands have the potential to provide many economic benefits, both directly from the products and services they provide, and indirectly by improving environmental conditions and natural balances. The woodland area in the United Kingdom in 2020 is 3.2 million hectares; 1.39 million hectares (43%) are independently certified as sustainably managed. Currently around 83% of UK woodland is managed for commercial production purposes, 18% is managed for conservation of biodiversity, and 4% is managed for public access (DEFRA 2016). Around 71% of tree planting per year is for restocking of felled areas for commercial purposes, including timber production and construction (DEFRA 2016).

The direct economic benefits provided by trees include timber production, construction materials, charcoal, and food. Additionally, many visitors are willing to pay to enjoy woodlands, creating potential further revenue streams.
Woodlands also provide opportunity for employment. Silviculture, the growing and cultivation of trees, provides employment in forestry management and urban planting. Silviculture is an ancient practice and has provided employment for hundreds of years. However, the industry has struggled to attract new talent and young people in recent years. To mitigate this the government has encouraged the development of several apprenticeships, degree courses and diplomas.

Asset value of woodland:

British woodland was valued at £130 billion in 2017 – the asset value of its environmental regulating services is 77% of the total value of woodland, recreational and cultural asset value is 18% of the total value and the provisioning of timber and fuel is only 6%. Research suggests that over 90% of woodland is non-market value, thus demonstrating the significant potential for an increase in economic market opportunity should a more commercial approach be desirable when balanced with the wildlife impacts of commercial forestry (The economic benefits of woodland, 2017).

Direct economic benefits by revenue stream

The total value of all forestry and associated primary production processing businesses in the UK is estimated to be £19.3 billion of GVA, and the industry employs over half a million people (Centre for Economic & Business Research, 2010)

a) Business: goods and services from woodlands:

Woodland products that can be sold:

One study based on Scottish forests found that around 200 non-timber forest products (NTFPs) can be sourced from woodland, 110 being edible, including medicinal/edible plants, moss lichen, fungi, bark, foliage, cones and wild or managed game (Emery, Martin & Dyke 2006).

The output of forestry goods increases by over £200 per year with each additional hectare of woodland (The economic benefits of woodland, 2017).

Many products can be derived from woodlands, such as firewood, edible fungi, foraged flora, wood for construction, charcoal, game species and so on. This can be a sustainable option if woodland is properly managed and can offer low carbon/carbon negative materials. A summary is provided below:

Woodland products:

- Timber - used in construction and furniture making; must be of sufficient quality for construction. In 2008, the UK's forestry and timber production were worth £6.4 billion, representing 0.5% of GVA, and employed 155,000 people.
- Wood fuel – a source of biofuel that is part of the renewable energy ecosystem service (Woodland natural capital accounts, UK: 2020). Wood is a common form of biofuel used in homes all the way up to large electricity generating power stations (Woodland natural capital accounts, UK: 2020). 31.6% of renewable electricity generation in 2018 was from burning biofuel including wood.
- Firewood & charcoal
- Mulch and humus
- Fruit and nuts produced by trees

Woodland services:

- Forestry & logging – contributed £472 million of GVA and employed 12,000 workers
- Wood product creation – contributed £1.3 billion of GVA and employed 79,000 people
- Paper and associated product making – contributed £2.8 billion of GVA and employed 64,000 workers
- Foraging – many businesses run foraging excursions and cookery classes
- Hunting – game from hunting can provide both food and sport can generate some income for woodland owners.

b) Recreation:

The value of woodland as a recreational source can be estimated as follows:

- An average of 700 visits for every hectare of woodland valued at £1 to £3.50 per visit. Woodlands are popular tourist destinations and many local economies benefit (Yard, 2004).
- In 2017 there were 475 million visits to woodlands and the public spent £515.5 million
- Visits to UK woodlands have increased by 39% since 2009 (Woodland natural capital accounts, UK: 2020).
- 99.9% of the population of England live with an hour's drive of a forest or woodland

c) Apprenticeships/work & education:

There is a high demand for skilled people in silviculture or forestry, as well as in sustainable woodland management and woodland education:

- Working in silviculture or in forestry, high demand for skilled services.
- All woodland in the UK should be sustainably managed and conserved.
- Woodland education – outdoor education – e.g. forest school, Green Tree school awards, 'bringing children closer to nature'

Direct economic benefit by industry

There are many possible ways of utilising woodland to drive economic growth. This section summarises the revenue potential and possible economic savings on a sector by sector basis.

Farmers:

Income generation:

- Products – sell timber, firewood, charcoal, fruit, branches etc.
- Agroforestry – plant trees within crops and plantations for other species. This land management approach provides many benefits including supporting biodiversity, improving soil quality, increased animal welfare and can provide payments for ecosystem services (PES) by combating climate change via carbon sequestration (Woodland natural capital accounts, UK: 2020).
- In the UK, agroforestry also includes hedgerows, silvoarable cropping, silvopasture and buffer strips (Woodland natural capital accounts, UK: 2020) – DEFRA reports that there are 547,600 hectares of agroforestry in the UK based on this board definition (Malignier & Balaguer 2017).

Economic savings:

- Soil quality – trees improve soil by adding nutrients and reducing soil erosion, which reduces spending on chemical products and extra soil and can provide higher quality product.
- Soil compaction – tree roots provide natural structure and stability to soil to help reduce poaching impacts by livestock and inadvertent soil run-off.
- Livestock – woodland provides shelter/shade and a source of food for grazers to add to diet, can improve health and reduce cost.

Conservation:

Income generation:

- Tourism – woodland is popular with tourists, can generate income from carparks and donations to put back into the woodland and conservation management practices.
- Increase funding – government funding for tree planting programmes, charities can provide plants and grants for planting projects.

Economic savings:

- Active management of woodland and woodland planting can be a cost-effective strategy for increasing habitat for biodiversity compared to other methods (Macmillan, Harley & Morrison 1998).

Forestry:

Income generation:

- Increase demand for services – tree planting will increase demand for those skilled in silviculture practices which will add value to market.
- Sell products – trees produce many products including timber, firewood, mulch, fruit and bark.

Tourism:

Income generation:

- Attract tourists - people are keen to enjoy natural woodland, paying for parking, tourist information centres, cafes, guided tours, bike hire, donations for the woodland.
- Woodland retreats – many people look to unwind and relax in woodland, access retreat market and resorts (e.g. Centre Parcs, Forest Holidays) – yoga, wellbeing, outdoor art, sculpture trails, adventure, education, childcare (summer camps) etc.
- Forest schools – teaching children about nature and learning about woodland.
- School residentials.
- Adventure – many activities including: mountain biking resorts, family cycling routes, running, orienteering, survival skills learning, high wires (e.g. Go Ape centres) etc.
- Camping /Glamping – stay on campsite, treehouses, enjoy walks and other activities in woodlands.

Economic savings:

- Natural attraction – requires limited costs to operate and maintain compared to other forms of tourism
- Free materials – woodland resources used for activities e.g. fort building, survival skills.

Energy:

Income generation:

- Energy production - use woodfuel to replace fossil fuel, reduce harmful emissions, utilise natural products.
- Biomass - using plant or animal material as an energy source or in industrial processes. Burning biomass is a low-carbon option as although CO2 is still released during the process the levels are far lower than alternative energy sources and it is considered a renewable energy source as all biomass crops sequester carbon as photosynthesis cycles the CO2 back into future crops. Wood is the largest biomass energy source.
- Charcoal – natural fuel to use in fires, long burning – use as alternative to peat.

Economic savings:

- Wood as a biofuel is cheaper to produce and transport than alternative fuels.
- Domestic supply reduced costs of transportation.

Other:

- Foraging – use woodland to find natural products for cookery, natural beauty products or medicinal products.

Human focused benefits:

There are also many indirect benefits on people and the economy from woodland, such as:

- Increasing property value: the presence of broadleaved woodland can increase the value of a building by 5-18% (Hobson & Eaton 2005; The economic benefits of woodland, 2017).
- Employee productivity: industrial areas and employment sites with green spaces have more productive employees (Wolf 1998) with greater job satisfaction (Kaplan 1993; (The economic benefits of woodland, 2017).
- Cheaper to maintain: green spaces with tree cover are reported to be cheaper to maintain than grassed areas (The case for trees 2010).

Additional benefits, such as those for wildlife, soils, water and landscape are discussed in detail on section XX and therefore excluded here.

Climate change impact on trees in the future

Likely impacts of climate change on woodland

Despite playing a key role in the response to the climate emergency, woodlands also face a significant threat from a changing climate.

Woodlands are threatened by climate change for the following reasons: temperature increases, droughts intensifying and increasing in frequency, floods worsening, new pests, and habitats becoming more fragmented. All of these factors result in biodiversity losses and declines in tree health.

The predicted effects of climate change in the UK are expected to be worse in the South / South East where summer droughts will become more frequent and severe and winters will become wetter. Some of these impacts are already occurring across the UK. These water fluctuations will likely result in high mortality of trees and slower growth rates.

Trees planted in the right place have the potential to slow some of the adverse impacts of climate change. However trees planted in the wrong place can actually have the opposite effect. For example trees planted on peat contribute to the drying of the peat and subsequent release of carbon dioxide to the atmosphere.

Climate change and species range shifts

Pests and diseases:

Globalised supply chains and the lack of UK tree nurseries has resulted in new tree pests and diseases entering the UK. Over 20 pests are currently attacking native trees and six are at epidemic levels. Additionally, another 11 pests and diseases are close to our borders and have a high chance of entering and surviving in the UK due to international trade and changing climate (Woodland Trust 2017). Additionally, native trees that are exposed to greater environmental stressors in the form of increased drought and higher temperatures will be more vulnerable to pests and diseases as their increased susceptibility and impaired resistance will make them easy targets for infection (Woodland Trust 2017).

Species range shifts:

The suitable habitat of many tree species is currently shifting due to climate change (Early & Sax, 2011). Fortunately extensive research has found that most affected species are able to track these changes and shift their range in response (Chen et al 2011). Many species are migrating or shifting ranges towards the poles to avoid the worst of climate change and the rising temperatures. For UK woodlands this means that new species may enter and either adapt to the conditions or alter the landscape. There is also the potential for increased competition between species which may lead to population declines (Bocedi et al 2013).

Temperature increases:

Climate change is predicted to increase the risk of forest fires in UK woodlands. Satellite data has shown that the number of fires in woodland and forests has increased in recent years and the impact areas have become larger (Woodland natural capital accounts, UK: 2020). Evidence suggests that the fires are triggered by mild winters with higher temperatures, heatwaves and extended periods of drought in the spring and summer (Woodland natural capital accounts, UK: 2020). Forest and woodland management are currently under review and is being adapted to mitigate the risk of wildfires. Several techniques are being trialled including species changes, more broken up planting and training of fire services (Woodland natural capital accounts, UK: 2020).

Permissions to plant woodland

Planning permission from the Local Planning Authority

At its most basic forestry does not constitute development under Section 55(2) of the Town and Country Planning Act

https://www.legislation.gov.uk/ukpga/1990/8/section/55

"Section 55 (2) The following operations or uses of land shall not be taken for the purposes of this Act to involve development of the land—
(e) the use of any land for the purposes of agriculture or forestry (including afforestation) and the use for any of those purposes of any building occupied together with land so used"

However whether forestry constitutes a change of use is based on what the current use of the land is. For example, if buildings were to be demolished to create a woodland then the demolition might constitute development where it's something that the Local Planning Authority (LPA) may want control over as part of their overall obligations (e.g. provision of housing). If the area to be planted is agricultural land the LPA would be highly unlikely to consider this as change of use, as the LPA do not exercise control over the amount of productive land for food production.

It should be noted that many of the elements associated with commercial forestry, for example tracks, buildings, seasonal caravans for workers etc are permitted development and therefore require Prior Notification to the LPA. Essentially permission for these things is implied and permitted, but the authority needs to be notified to act as a balancing check for wider impacts.

If there is uncertainty about whether your proposal requires planning permission or prior notification there is a function within planning for official advice called "Do I Need Planning Permission". This costs around £30 and can be accessed here:

https://www.cornwall.gov.uk/environment-and-planning/planning/planning-advice-and-guidance/do-i-need-planning-consent-or-building-regulations/

Note that the owner of the land needs to grant permission to plant so tenants or other occupiers would need to obtain this..

Permission from the Forestry Commission

In England permission is needed from the Forestry Commission if you are planting an area exceeding two hectares, or the site you want to plant on is in a high-risk habitat. If these apply, then you must contact the Forestry Commission and complete an Environmental Impact Assessment.

https://www.gov.uk/guidance/environmental-impact-assessments-for-woodland-overview

You can check whether the area is protected and high risk using Forestry Commission map browser.

https://www.forestergis.com/Apps/MapBrowser/

Correctly siting your woodland

Ecological aims of woodland siting

New woodland (and natural regeneration areas) can be used to bolster existing habitat. The Lawton Review 'Making Space for Nature' sets out the simple aim of all habitat creation, to create: **More, Bigger, Better and Joined**.

This encourages woodland to be proposed in **more** places to create **bigger** areas of woodland, leading to better habitat resilience and better **joined up** and connected woodland to allow wildlife to move through the landscape more successfully. The caveat is that woodland should only be created where it would have naturally occurred, and not where there are already high quality habitats present. The aim of this section is to help you understand both general and site specific issues which should be considered when designing woodland.

Woodland management should also aim to **'Protect the best, restore the rest'** so it is important to protect existing woodland habitat to prevent it being removed/ degraded in the first place.

As trees mature the benefits they provide for biodiversity increase, particularly through the provision of habitat that is important to the survival of certain species, such as bats. The bark of older trees are also often covered with notable species of lichens and mosses. Additionally, dead wood habitats are very valuable for biodiversity and a well-managed woodland should have a range of tree ages, from saplings to dead wood.

Figure 4: An existing Cornish landscape before and after woodland creation: Prepared as part of Keyn Glas: Green Ribs, Environment Designated Funds initiative. Credit: Arup on behalf of Highways England.

General siting considerations

There are some general considerations when designing your tree planting area:

- Underground services and buildings – You should consider issues such as underground services (water, electricity etc), the proximity of building foundations, and the eventual height and spread of the trees in terms of shading of buildings and potential impact on overhead lines.

- Planting position, height and spread – knowledge of the final size and spread of trees is needed to ensure the trees have sufficient space to grow without disturbing the existing habitat. When planting woodland trees, a minimum 2-meter gap between each tree is recommended. For more species diverse woodlands, woodlands where the aim is biodiversity and a tiered canopy, and habitat such as wood pasture, a far greater spacing would be beneficial.

- Predation and damage protection – It is essential to design suitable protection against predation of trees, for example from grey squirrels, rabbits and deer. Woodland planting which is not protected from these species is highly unlikely to reach maturity in good health, and may be killed altogether. If deer are the main issue then fencing may be viable for larger plantations (at least 180cm/ 6 foot tall fencing is needed for deer). Depending on the gauge of fencing rabbits may also be kept out using fencing (normal stock fencing is too large gauge to stop rabbits). For grey squirrel predation a mixture of trapping and shooting is the best option. Note that poisons such as warfarin are no longer licenced for grey squirrels.

- Footpaths & Access – If there are existing footpaths or public rights of way these must be maintained on their original routes. To alter them requires a legal process which is time consuming. If you would like to create a new pathway bear in mind factors like how people will access the route (by foot, by car, on horseback etc), how well drained the path will be, and how any tree management operations you will need to do will interact.

- Local community – New planting areas will affect the local landscape, so you must consider what others will think of it and how it will sit within the landscape.

- Historic context - When considering where to site your woodland, and how it may fit into the landscape, using the historic maps can give useful clues. The 1880 Cornwall maps which show a largely pre-industrialised landscape are a good starting point for where woodland and associated habitats best sit. You can access these maps at Kresen Kernow,

  https://kresenkernow.org/

Site specific considerations

Desk based assessment

A desk based assessment will identify any protected areas on your proposed planting site which would potentially make it unsuitable for tree planting.
In England 8.3% of woodland has a protected site designation, either SSSI or SAC (Woodland natural capital accounts, UK: 2020).

To protect habitat and biodiversity human disturbance and planting activities are restricted in the following areas:

- Areas of Outstanding Natural beauty (AONB)
- Sites of Special Scientific Interest (SSSI)
- Special Areas of Conservation (SAC)
- County Wildlife Sites (CWS)
- Nature reserves

In order to plant within these areas the Forestry commission must first be contacted and an Environmental Impact Assessment completed.

In Cornwall 27% of the county is designated as an AONB across 12 separate sites. Additionally, there are 167 SSSIs, 81 designated for wildlife, 54 for geological interest and 32 for both.

Across the county there are a further 17 SAC sites, many SPA sites and several Ramsar wetlands.

Furthermore, Cornwall has three National Nature Reserves (NNR) and 14 local nature reserves.

You can access a map showing protected sites on the Cornwall Council website Interactive Map: https://map.cornwall.gov.uk/website/ccmap/

Habitat survey

Following the desk based assessment you need to conduct a habitat survey of the site. This can be completed by an ecologist. It is very important that woodland is not planted on already high biodiversity habitats, for example heathland or species rich grassland. Planting trees on these habitats reduces biodiversity and can have associated adverse impacts, for example by drying soils and releasing carbon to the atmosphere (Global Change Biodiversity, 2020; NatureScot, 2020). This is why new afforestation on soils with more than 50cm depth of peat is not permitted in the UK and it is highly recommended that all heathland and peat sites are excluded from planting proposals. Unimproved grasslands, species rich grasslands, and wetlands (marshes) should also be excluded as they already offer biodiverse habitats and store carbon. Additional shading and drying impacts from trees would adversely impact on such habitats.

There is more information on habitats which are and are not suitable to plant on in **appendix 4** and on this easy to read infographic, produced by Cornwall Wildlife Trust's Right tree, right place project: (Cox and Hocking, 2020)

https://www.cornwallwildlifetrust.org.uk/sites/default/files/2020-04/CWT-Right-Tree-Right-Place-WEB.pdf

Historic mapping

The next consideration is the historic and landscape context of your site, as some sites, for example in the AONBs of Cornwall, have specific value as their existing habitat type. The moorlands of West Penwith and Bodmin Moor would be good examples of this, as would historic sites such as disused mine sites. If this is the case for your site woodland planting is unlikely to be suitable.

The next step is to consider what habitats would have occurred naturally on the site. In order to identify this it is necessary to look at historic maps. This can prove interesting detective work, and accessing the records at Cornwall's Historic Records Centre, Kresen Kernow, https://kresenkernow.org/ is a good place to start.

The oldest easily accessible maps are from Thomas Martyn in 1748, but this shows only the larger woods. Generally speaking these are all in steep-sided valleys, mostly in the eastern half of Cornwall.

https://curiosity.lib.harvard.edu/scanned-maps/catalog/44-990127200480203941

The 1-inch OS maps from c 1810 are preferable to the 1880s maps in order to provide a broad picture of woodland in Cornwall. The 1-inch maps were based on 2-inch drawings that are discoverable online (via Old Maps Online). This example link takes you to the Liskeard area, and again it is notable that the woodland occurs in steep-sided valleys: https://www.oldmapsonline.org/map/britishlibrary/002OSD000000016U00322000

When looking at historic maps place-names can suggest early woods, including medieval Cornish names like cos and kelli, but this will not identify precisely where the woods were.

As well as looking at blocks of woodland it is also very important to consider more discreet areas of canopy cover, including former orchards and hedges.

Orchards

Discovering and recreating former or abandoned orchards offers great opportunities to provide valuable wildlife habitats alongside a productive fruit crop. If you are planning on restoring an existing orchard you should seek expert advice in order to protect existing wildlife, landscape and historic interest. If you are creating a new orchard there are many Cornish varieties of fruit trees to choose from, and these can be readily found at local nurseries. You can read more about the history of orchards in Cornwall here: https://www.cornwall.gov.uk/environment-and-planning/trees-hedges-and-woodland/apples-and-orchards/ and there are lists of suitable varieties to choose from here: https://www.cornwall.gov.uk/environment-and-planning/trees-hedges-and-woodland/apples-and-orchards/orchards-recommended-varieties/

Hedges

Of enormous importance in Cornwall is the Cornish hedge, which in some landscapes is often tree lined and can contribute greatly to canopy cover. The wooded effect achieved by large hedge trees is known as bocage. The 1880's OS maps show areas of bocage, but it should be noted that by the 1880's one or two generations of "agricultural improvers" had already been removing large trees from hedge lines. Apart from the granite uplands there could have been bocage virtually everywhere in lowland Cornwall and replacing trees in suitable hedges is therefore a great opportunity to create canopy cover. Where existing hedge trees are present managing them so that only the lower front faces of them are trimmed (and only then in rotation so that no more than one face per year is cut) offers benefits for wildlife, the landscape, and stock who can shelter under them.

It is apparent that many woodlands in Cornwall would have occurred in steep sided valleys with wooded marshes on the valley bottoms and linkage through large tree lined hedges. Concentrating woodland creation and restoration effort in these areas therefore would deliver for biodiversity and also reinforce the historic character of the whole of Cornwall's landscape.

Natural England mapping

Data from Natural England's habitat networks illustrates that most of the canopy cover in Cornwall is located to the south of the county and is concentrated along estuaries and sheltered valleys (Figure 5). This is particularly true for wood pasture and parkland which is located along several key rivers: The Fal, Fowey and Tamar. Traditional orchards and ancient woodland is found more widely spread across Cornwall but not along the exposed northern coast, within upland heath, or along the granite moors.

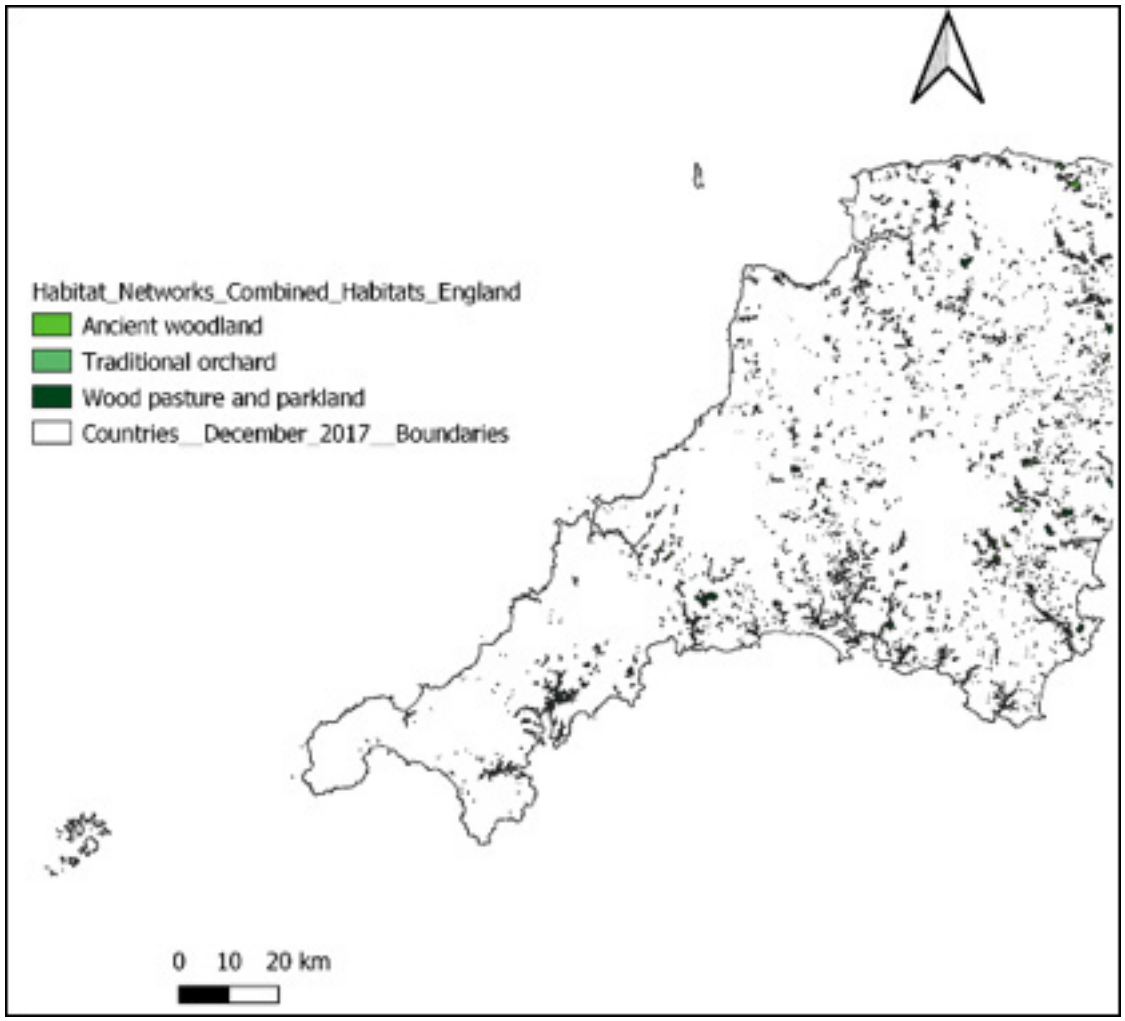

Figure 5: Woodland Habitats in Cornwall & Isles of Scilly. Data taken from Natural England Open Data - Habitat Networks (Combined Habitats) (England). Map created in QGIS.

Opportunity mapping using Lagas

If you would prefer to access a single set of mapping in order to identify the woodland planting opportunities on your site then the University of Exeter (through the Tevi project) has developed the Lagas mapping resource. This has been created recently (2019-2020) and is delivered in partnership with the Cornwall Wildlife Trust, Cornwall Council and the Cornwall Development Company

There are many sets of useful maps on the Lagas site but in terms of identifying where woodland opportunities lie the woodland ranking maps here: https://lagas.co.uk/app/product/woodland-landscape and the woodland opportunity maps here: https://lagas.co.uk/app/product/woodland-opportunity-map are most useful.

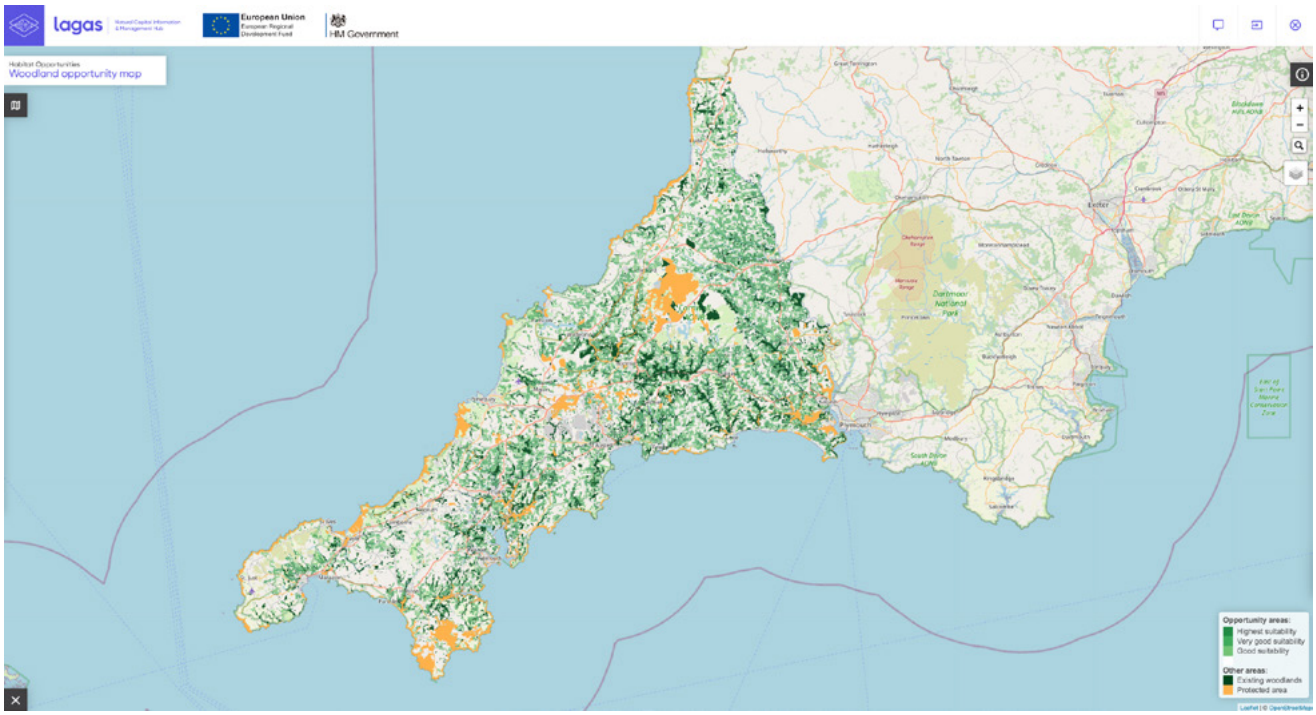

Figure 6: University of Exeter Woodland opportunity mapping (Lagas) – current woodland in Cornwall shown in dark green, protected areas in orange, and opportunity areas in lighter green tones.

Planting your woodland

How to create woodland

Tree planting is traditionally carried out between October-March when the tree is dormant. Trees planted at this time of year can be planted bare root, when they are cheaper to buy and easier to handle. They also do not require pots and are cheaper to transport, making their carbon impact less than heavy potted plants. This time of year is strongly recommended for planting as trees planted outside this period require watering and careful management. This makes planting in the summer season only really suitable for individual or garden trees. As a general rule younger trees are quicker to establish but can be more likely to be damaged by deer or rabbits if not protected.

The method of planting depends on the species of tree and the size of the sapling. Some planting methods are given below. The amount and type of site preparation depends on the previous use of the site (More trees more good: a guide to creating small native woods in England, 2020). You can find more advice on planting trees in the Woodland Trust's "Guide to planting trees in UK" https://www.woodlandtrust.org.uk/media/1168/twigged.pdf

a) Pit planting:

1. Using a small spade to take a turf out of the ground, turning it over and splitting it in two.

2. Dig the rest of the hole and free up the soil in the bottom of the hole.

3. Place the young tree into the hole and gently push the roots into the soil.

4. Look for the collar of the tree – the point where the tree has grown above the ground – and make sure the hole is up to this point.

5. Place the split turf back into the hole, with the two halves on both sides of the tree and the grass side facing down into the hole.

6. Stamp the ground with your foot to firm it in.

Appropriate spacing between new trees is essential to ensure growth. Overcrowding can lead to nutrient deficiencies, increased disease, pest transmission, and weak flowering.

b) Direct seeding:

- Sowing seeds is the more traditional method of creating a woodland but is not commonly used now. Preparation of the soil is key to successful establishment.
- Seeds can either be distributed randomly or drilled in lines.
- Larger seeds, e.g. oak, require a greater depth and more space to grow so should be drilled, or hand planted if small numbers are to be sown.
- Soil types affects sown depth.
- Tree seeding typically takes place in autumn or spring to mimic natural process of seed, fruit and nut drop (autumn) and germination (spring).

c) Natural colonisation/ regeneration:

- This refers to allowing seeds which have been dropped by existing trees, carried into sites by wind, or transported by wildlife to naturally establish (https://www.forestresearch.gov.uk/research/lowland-native-woodlands/natural-regeneration-of-broadleaved-trees-and-shrubs/#:~:text=Natural%20regeneration%20is%20the%20process,using%20transplants%20grown%20in%20nurseries)

- In areas where the land was historically woodland the habitat can be left to regenerate using existing seed banks in the soil and/or encroachment from surrounding woodland. This can include scrub establishment and succession to woodland over time and this is a valuable way of allowing a matrix of habitats which are suitable for wildlife to be delivered.

- Natural colonisation/regeneration is a good option if there is a good local seed source, the ground cover is poor, there are few predators and little need for protection, or the availability of ongoing management will be limited.

- The advantages of natural colonisation/regeneration include low costs, local species and the random spacing of trees that are hardy and strong rooted.

- Disadvantages can be slow establishment, limited instantaneous species diversity and very little control of where trees will grow.

Selecting the right species

It is very important to select the right species to plant. The National Vegetation Classification W10 woodland community is the most common "standard woodland" in Cornwall with W10e on more acid soils and W10c in other areas. Examples of these communities are given below but Rodwell 1991 British Plant Communities, Volume 1, Woodlands and Scrub, also provides a good starting point for woodland species lists.

It must be noted that woodlands are more than just trees, they also need shrubs and understory to form a properly functioning habitat. The lists below therefore include some smaller shrub species, such as rosa sp. and also climbers such as honeysuckle. These shrubs are usually best planted along the woodland edges, glades and rides (gaps and paths) where light levels and moisture are higher.

Table 1 – Suggested species and frequencies for W10 woodland

Species	Native	W10	W16	W7	Notes
English Oak *(Quercus robur)*	Cornwall	4(1-10)	2(1-8)	1(1-6)	*Most common oak in Cornwall*
Sessile Oak *(Quercus petraea)*	Cornwall	2(1-10)	2(1-10)	2(1-9)	
Downy Birch *(Betula pubescens)*	Cornwall	1(1-9)	2(1-8)	2(1-10)	*The more frequent of the 2 birches in Cornwall*
Silver Birch *(Betula pendula)*	Cornwall	2(1-10)	4(1-10)	1(1-8)	
Rowan *(Sorbus aucuparia)*	Cornwall	1(1-5)	2(2-4)		
Holly *(Ilex aquifolium)*	Cornwall	1(1-7)	1(2-4)	1(1-4)	
Alder *(Alnus glutinosa)*	Cornwall	1(1-9)		4(1-10)	
Common Beech *(Fagus sylvatica)*	UK	1(1-10)	1(1-7)		
Yew *(Taxus baccata)*	Archaeophyte	1 (1-9)			
Small-leaved Lime *(Tilia cordata)*	UK	1(1-5)			*Very rare in Cornwall*
Aspen *(Populus tremula)*	Non-native	1(1-4)	1(3-4)		
Sweet Chestnut *(Castanea sativa)*	Archaeophyte	1(1-10)	1(3-9)		
Scots Pine *(Pinus sylvetris)*	UK	1(1-10)	1(1-8)		
Sycamore *(Acer pseudoplatanus)*	Non-native	2(1-9)	1(1-4)	2(1-5)	
European Ash *(Fraxinus excelsior)*	Cornwall	2(1-8)		3(1-7)	
Wych Elm *(Ulmus glabra)*	Cornwall	1(1-7)		1(1-4)	*Widespread but rare in Cornwall*
Common Hazel *(Corylus avellane)*	Cornwall	3(1-10)	1(3-5)	2(1-8)	
Common Hawthorn (*Crataegus monogyna)*	Cornwall	2(1-7)	1(1-2)	2(1-6)	
Guelder Rose *(Viburnum opulus)*	Cornwall	1(1-4)		1(1-3)	
Crab Apple *(Malus Sylvestris)*	Cornwall	1(1-2)			*Rare in Cornwall*

Species	Native	W10	W16	W7	Notes
Blackthorn *(Prunus spinosa)*	Cornwall	1(1-7)		1(1-4)	
Wild Cherry *(Prunus avium)*	Cornwall	1(1-5)			
Elder *(Sambucus nigra)*	Cornwall	1(1-7)		1(1-4)	
Honeysuckle *(Lonicera pericylmenum)*	Cornwall	4(1-8)	1(1-6)	2(1-6)	
Field-rose *(Rosa arvensis)*	Cornwall				
Dog-rose *(Rosa canina)*	Cornwall	1(1-6)			
Spindle *(Euonymus europaeus)*	Cornwall				*SE Cornwall and catchments of Fal, Camel, Fowey & Tamar, elsewhere it is rare*
Field maple (Acer campestre)	UK	1(1-4)			
Grey willow *(Salix cinerea)*	Cornwall			1(1-9)	
Goat willow *(Salix caprea)*	Cornwall			1(1-4)	
Hornbeam *(Carpinus betulus)*	UK	1(1-9)			*Relatively rare in Cornwall*

The table above shows the constancy (measured 1-5) and abundance (measured 1-10) of each species. Constancy relates to, if a habitat was divided into equal parts, how many parts would contain that species, while the abundance is when the species is present how abundant is it. The abundance is given as a range and uses the Domin scale).

The above species list is taken from Rodwell 1991 British Plant Communities, Volume 1, Woodlands and Scrub:

W7 Alnus glutinosa – Fraxinus excelsior – Lysimachia nemorum woodland.

W10 Quercus robur – Pteridium aquilinum – Rubus fruticosus woodland.

W16 Quercus spp. – Betula spp. – Dechampsia flexuosa woodland.

W10 is the commonest native broadleaved woodland that occurs in Cornwall, W16 occurs on the more acid soils while W7 is a wetland woodland.

When designing your woodland it is a good idea to consider glades and rides (gaps and paths) which give a break in the canopy and so offer more light at ground level. This encourages greater biodiversity and on a practical level allows easier access for people, be it for maintenance or recreation.

There are many seed mixes available for such areas and, as with the selection of tree species, knowing the local flora and soil conditions, as well as seeds which may already be present is very important. The seed mix given below is not therefore prescriptive but does provide a useful starting point as it provides a range of species, some of which will thrive in most conditions:

Table 2 – Suggested species for woodland glade and ride planting

% of Total	Latin Name	Common Name
25%	Cynosurus cristatus	Crested Dogstail
7%	Festuca ovina	Sheeps Fescue
7%	Trisetum flavescens	Golden Oat-Grass
5%	Leucanthemum vulgare	Ox-eye Daisy
5%	Lotus corniculatus	Birdsfoot Trefoil
4%	Centaurea nigra	Common Knapweed
4%	Plantago lanceolata	Ribwort Plantain
4%	Ranunculus acris	Meadow Buttercup
3%	Acheillea millefolium	Yarrow
3%	Agrostis capillaris	Browntop Bent
3%	Anthoxanthum odoratum	Sweet Vernal Grass
3%	Betonica officinalis	Betony
3%	Galium verum	Lady's Bedstraw
3%	Rhinanthus minor	Yellow Rattle
3%	Succissa pratensis	Devil's-bit Scabious
2%	Agrimonia eupatorium	Agrimony
2%	Filipendula ulmaria	Meadow Sweet
2%	Knautia arvensis	Field Scabious
2%	Primula veris	Cowslip
2%	Prunella vulgaris	Self Heal
2%	Ranunculus bulbosus	Bulbous Buttercup
2%	Trifolium pratense	Red Clover
2%	Leontodon autumnalis	Autumn Hawkbit
2%	Leontodon hispidus	Rough Hawkbit

Species suited to Cornwall

Cornwall is home to diverse tree species from ancient woodland to modern Eucalyptus plantations. The county's mild and wet climate allows for tropical species to grow and thrive alongside native trees.

When selecting tree species it is important to plant trees that can support Cornish biodiversity, and native tree species are normally best placed to do this.

Cornwall Council has a helpful list of tree species native to Cornwall (https://www.cornwall.gov.uk/media/3622895/Native-trees-and-shrubs-in-Cornwall-WEB.pdf) and Cornwall Wildlife Trust's Tree Planting Guide also provides excellent advice on what to plant and where (https://www.cornwallwildlifetrust.org.uk/sites/default/files/2020-04/CWT-Right-Tree-Right-Place-WEB.pdf)

Photo by: @lifeforstock

Photo by: @leonidassantana

Where to source trees

It's always best to source locally grown trees from suppliers with fully traceable supply chains so you know where they have been grown, the methods that have been used and that these trees are not carrying diseases or pests.

The Woodland Trust has launched a scheme called UK and Ireland Sourced and Grown Assurance Scheme (UKISG) which is a voluntary initiative for forest nurseries. The scheme identifies the provenance of stock and assures that trees have been grown from seed solely in the UK and Ireland.

Auditors inspect and approve participating nurseries to be awarded this standard. Participating nurseries can then use this to identify and market their products as UK grown. UKISG is not yet an industry standard but is the benchmark for procurement at the Woodland Trust.

Currently 26 nurseries have qualified and been awarded with UKISG status. Within the South West these nurseries are:

- Perrie Hale Nurseries, Devon
- Exmoor Trees, Somerset
- WeeTree Nurseries, Somerset
- Moor Trees, South Brent
- Tamar Trees, Launceston

Managing your woodland

To thrive woodland wildlife needs open spaces with coppices, rides and glades, and so management needs to create these areas to let in sunlight and life.

If managed sustainably, woodlands offer huge benefits in terms of biodiversity, public access, recreation, landscape quality and additional ecosystem services, as well as a supply of timber and other woodland products.

Without correct woodland management we will continue to see a net loss of woodland plant diversity and abundance, no matter how many new woodlands are planted.

This section therefore sites out a suitable management plan for areas of new woodland planting (including the W10 woodland mix given above).

As discussed above in section **'Planting your woodland'** planting will need to be undertaken during the winter period when bare-rooted stock is available and can be planted successfully (November – March).

Table 3 – Woodland planting maintenance schedule of works

Phase	Works	Timing	Programming
Establishment Years 1 to 5	Biodegradable Polythene shelters, stakes and bio-degradable mulch mats are to be checked regularly and replaced/ re-secured as required throughout establishment period (three years)	Not month specific	Year 1 to 3
	Hand weed tubes/guards where necessary to maintain a weed free area with area of mulch mat (0.6 x 0.6m)	May and August (twice a year)	Year 1 onwards
	Annual cutting with strimmer or similar suitable tool to maintain weed free areas around mulch mat and prevent encroachment.	July	Year 1 onwards
	At the end of each summer until five years from planting, check all planting for failures. Ensure any plants that have failed are replaced at the earliest opportunity to maintain an overall stocking rate of 100% through the maintenance period. If failure rate is less than 1 in 10 replace with same species. If failure rate is noticeably higher in specific species query potential disease/ pest presence and replace with appropriate alternative.	August	Year 1 onwards

Phase	Works	Timing	Programming
Year 5 onwards	Cut sides as necessary to maintain form, allowing specimens to reach natural height.	January - March	Year 5 onwards
	When specimens reach an overall height of 9m, around year 10 for nurse species or year 15 for hardwoods commence thinning programme. To be carried out by qualified arboricultural contractor with aim of removing dead or diseased specimens, reducing competition for light and growing space and creating an evenly distributed canopy of open foliage. Ensure that thinning is only undertaken in a manner that does not compromise screening value of the woodland. Cuttings should be left on site in brush piles for habitat value.	Annually on 10 year rotation	Year 10-20
	Encourage natural regeneration of mosaic habitats through long rotation felling cycle and annual shrub clearance to prevent encroachment. Work to be undertaken by qualified arboricultural contractor. Ensure that thinning is only undertaken in a manner that does not compromise screening value of the woodland.	Every 10 years	Year 20 onwards

Within woodland ride areas (paths), a central 2m strip should ideally be maintained slightly more intensively with 2 to 3 cuts per year (for example in February to reduce the vigour of grasses, late August once the majority of flowering is complete, and October if a late summer/ autumn flush needs reducing in height), whereas the remainder of the ride should receive just an annual cut in late summer (note if a mild winter occurs a cut in February can help reduce vigour and still allow spring flowering). This is to enhance the structural diversity of the vegetation and diversify the maintenance pressures (which should be beneficial to biodiversity).

Table 4 – Woodland rides maintenance schedule of works

Phase	Works	Timing	Programming
Central 2m strip – short grassland			
Year 1	Autumn Sown (First Year) March Cut to 4-7cm if there is sufficient material. May Cut to 4-7cm in early May. September Cut to 4cm after flowering. In all cases, remove the clippings.	First cut in March	From year 1
Year 1 onwards	Cut to 4-7cm to remove excess grass.	March	From year 1
	Cut to 4cm after flowering. In all cases, remove the clippings.	September/ October	From year 1
	Generally clear non-biodegradable rubbish and control invasive species if required.	As required	From year 1
Sides– long meadow grassland			
Year 1 onwards	Autumn sown (first year) At end of summer following seeding, after flowering, cut to 100mm. Remove cuttings to piles in adjacent woodland edge areas.	August – late September	From Year 1
	Generally clear non-biodegradable rubbish and control invasive species if required.	As required	From year 1

Risks threatening successful tree establishment

Planting the right tree in the right place is essential. Equally important is ensuring that the planted sapling is protected and managed to give it the best possible chance of establishing successfully and flourishing.

At a young age saplings are at risk from a number of factors that could stunt growth or result in the tree dying. These key risks are presented by predation, grazing, weeds, wind and disease:

Predation poses one of the main risks to the successful establishment of woodland. At a young age saplings are vulnerable to deer and rabbit grazing, which can kill or stunt a small sapling. As trees grow larger the risk of rabbit damage reduces but the threat from deer remains. If trees survive to semi maturity, at around 15 years old, they become likely to be damaged or killed by grey squirrels which ring bark and strip patches of bark, making them vulnerable to disease and becoming misshapen. The best protection against rabbits comes in the form of tree guards. The best protection from deer comes from fencing, although tall tree guards provide some protection for small trees (until they exceed the height of the guard). Shooting and trapping is the most suitable form for control for grey squirrels. There is potential for natural predation of grey squirrels from pine martens but this species will take some decades to become widespread in Cornwall as the closest large populations are currently in Wales.

Grazing animals present a threat to young trees as they are drawn to saplings and green shoots that contain high levels of nutrients. Deer, grey squirrels, and rabbits are covered above but livestock also pose a threat and must be kept away from immature trees. Tree guards and fencing provide the most common form of protection from this threat.

Competitor plants including grasses can outcompete saplings for light and nutrients. Removing competitor plants regularly until the sapling is sufficiently established is key to managing this risk. Creating a 1 meter diameter cleared area around the base of a sapling can also help protect it from voles.

Wind presents a risk to young saplings as strong gusts could topple the plant, while coastal winds also carry salt that scours and damages the sapling. Maintain or establish windbreaks, ideally natural ones such as Cornish Hedgerows because they encourage biodiversity and pollination whilst protecting tree planting sites from inclement weather.

Cultivation impacts from farming and horticulture can harm existing and newly planted trees. Intensive agriculture within close proximity to tree roots can harm the soil components that trees need to survive, including Mycorrhizal fungi. Providing enough soil complexity and connectivity by allowing for larger root protection areas when creating new woodland will help trees to thrive.

Preventing the introduction or spread of harmful **diseases** such as fungus and tree pests is important. Although these organisms can be spread naturally, human activity is a common mechanism of transmission into previously inaccessible environments and can spread diseases further and in greater densities than natural forces (Brooker 2019). It is estimated that 95% of ash trees have been lost to ash dieback and that Dutch elm disease has taken 60 million trees. One of the main forms of tree disease transmission is via plant imports, as well as uncleaned equipment. Purchasing saplings locally and from reputable stock provides the best mitigation for this risk.

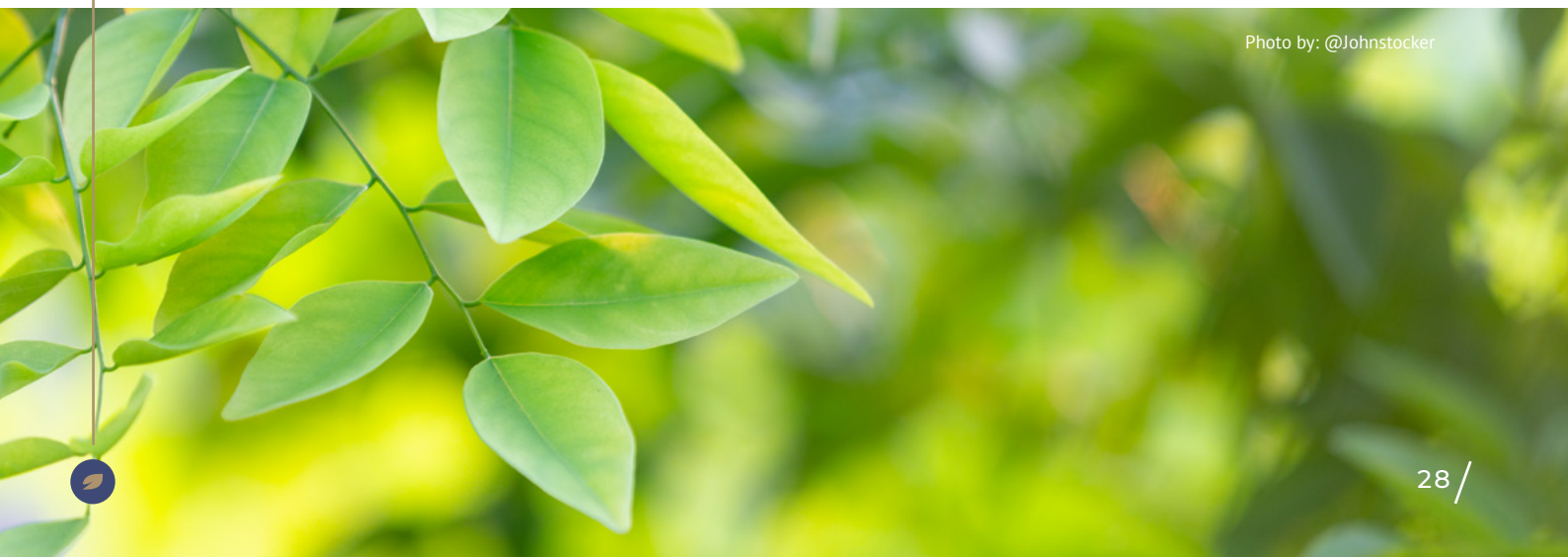

Photo by: @Johnstocker

Protection options and approaches

There are a range of options available for protecting saplings. In most cases a combination of solutions is needed.

Fencing:

Fencing decisions need to be made on a site by site basis based upon the size of the woodland, the local population of deer and rabbits (fencing does not exclude grey squirrels) and the amount of ongoing management which is available. Generally the cost of fencing is too great for it to be of practical, making the use of tree guards coupled with predator control the practical solution. However if fencing is to be used some other elements need to be considered:

- The choice of fence depends on the reasons for implementing protection. For instance, if deer are the issue then sufficiently high and strong deer fencing must be used.
- Possible issues with fences being a barrier to walkers and other land users.
- The straight edges caused by fences can have significant landscape effects if badly positioned. It is recommended that, where fences will result in a visual intrusion, they should be set within the edge of the woodland or trees should not be planted up against the entire length of the fence.
- The complete removal of large grazing animals by fencing may also cause a decline in woodland biodiversity over a number of years (Gill, 2000).

Tree guards:

Generally shaped as tubes and made of plastic these guards surround each individual tree and prevent grazers from accessing the sapling. When using a guard its height needs to equal or exceed that of the local pest species. There are difference tubes available for local conditions such as pests or wind. However, all individual guards will need to be cut from the tree once it's established, and disposed of appropriately. Furthermore, it should be noted that not all tree species benefit from tree guards and some species are more appealing to browsers and grazers than others.

Local stock:

Sourcing from tree nurseries within the UK reduces the demand for imports and supports local businesses. Furthermore, buying from local vendors with fully transparent and traceable supply chains that are disease free is crucial in both avoiding infected trees, and in minimising the spread of these deadly diseases.

Reducing grazing pressures:

Culling species such as deer and grey squirrels to control the population and reduce the grazing pressures on newly planted trees is common practice, but it must be noted that licences are required for the culling of specific deer species at specific times of the year. No such restrictions apply to grey squirrels which are an invasive non-native species. Reintroducing natural predators is also an approach that is gaining traction and evidence of effectiveness. For example grey squirrels are predated by pine martens and a number of pilot schemes are reintroducing martens and observing positive impacts on the numbers of grey squirrels present (Sheehy et al, 2018).

Key to selecting the most sustainable and effective option is to assess what protection is realistically needed for your site. The Forestry Commission has created a useful flow chart to guide your decision (Figure 7; Forestry Commission 2020).

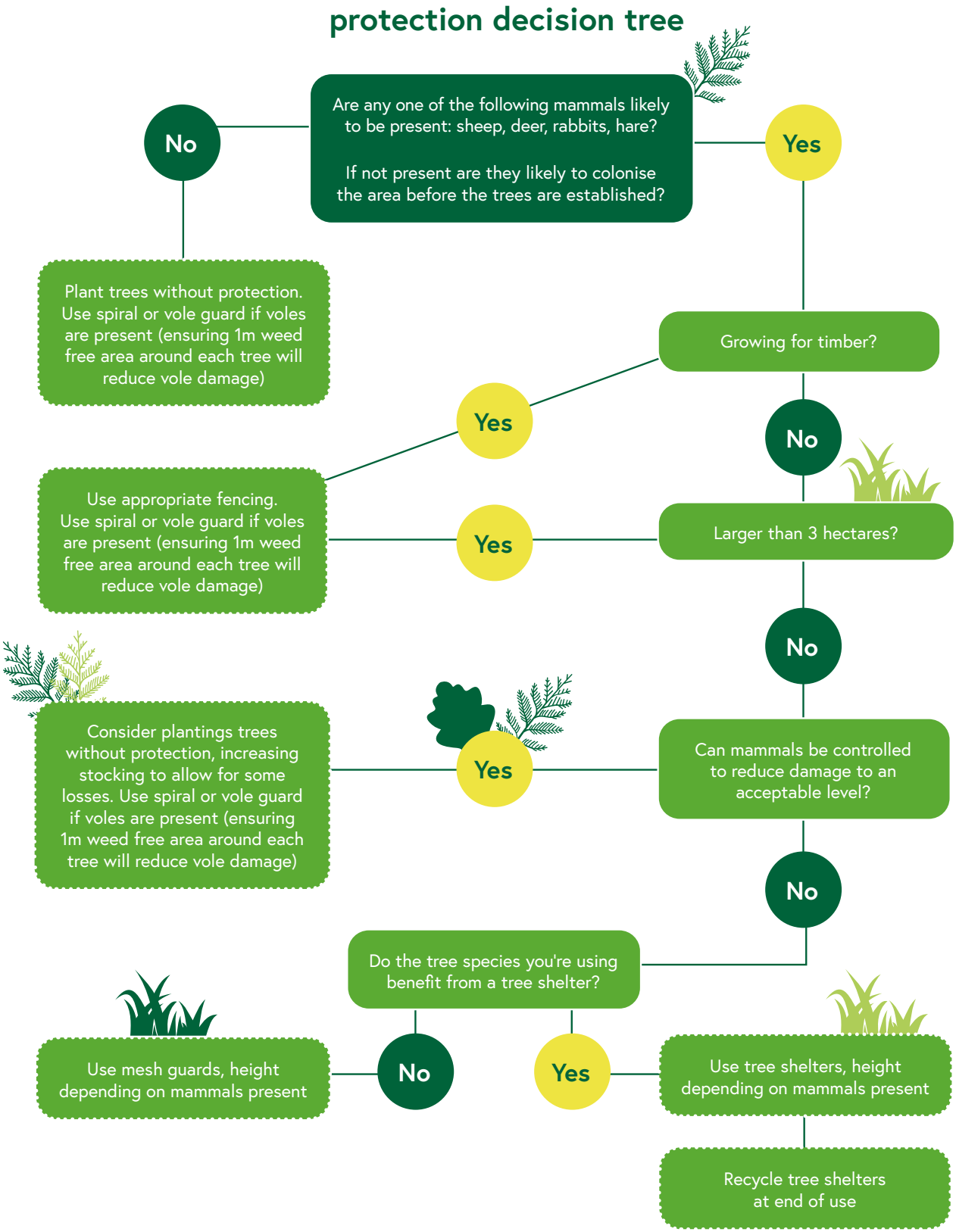

Figure 7. The Forestry Commission's Planting broadleaf tree – protection decision tree.
Source: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/896121/Tree_shelters_guide.pdf

Tree guard considerations

Tree shelters need to be robust enough to last the establishment period of a tree which could be up to five years. Plastic has been the predominant material used in recent decades because it can withstand environmental conditions, but it does not biodegrade so must be removed or it will damage the ecosystem.

Non-biodegradable tree guards present a major environmental risk if they are not recovered and reused, or disposed of. In recognition of this challenge there are a growing number of biodegradable options that can help deliver more environmentally friendly and sustainable outcomes. Although these options are less harmful, issues of longevity have arisen due to their biodegradable nature (Forestry Commission, 2020).

Below are a range of guarding options:

Metal tree guards: Strong, hard-wearing structures that protect sapling trees from pests and can be reused. Ideal for protecting against large grazers including deer and livestock Available for purchase from: https://www.metaltreeguardsandfencing.co.uk/

Image 1. Metal tree guards

Cane and spiral guards: A low cost option that protects against smaller pests such as rabbits, hares and mice. Available for purchase from: https://www.green-tech.co.uk/tree-planting-products/tree-planting-protection-packages/rainbow-tree-spiral-guard-and-bamboo-support-cane-packages

Image 2. Spiral guard and bamboo support cane tree protection.

Biodegradable guards: Often able to compost after use and some even benefit the tree by providing nutrients as they breakdown. Available to purchase from: http://www.ezeetrees.com/tree-guards

Image 3. Biodegradable tree guards

Paper guards: Made from sustainable PEFC™ long fibre kraft board which can be left to rot in the landscape. These options tend to biodegrade after two growing seasons and are available to purchase from: https://gogreenguards.com

Image 4. Paper tree guards

Photo by: @lifeforstock

Conclusions

The thought of rolling acres of peaceful woodland, with its dappled shade and birdsong, drives many people to plant trees. Tempting though this vision is this document sets out why getting the right tree in the right place is so important.

In the wrong place, such as on peat or species rich grassland, woodland can cause the loss of species and the release of millennia of stored carbon into the atmosphere. In the right place woodland can create a habitat for many thousands of species, and a place for recreation and contemplation for humans.

Working out where the "right" and "wrong" places are requires a little research and fact finding, as set out within this document. The fact finding doesn't end there, with species selection being the next piece in the puzzle. Making sure the species selected suit the site, the management which will be possible, and the eventual aims of the planting scheme, are all factors.

Once planted the management of the site is key; planted woodland habitats do not look after themselves, and either a natural succession approach or a careful management plan are needed. To thrive, woodland wildlife needs open spaces with coppices, rides and glades to let in sunlight and life. It also needs protecting from threats, be that from deer, grey squirrels and rabbits, or over enthusiastic human recreational pursuits.

As set out above, ensuring the successful delivery of a Cornwall wide woodland creation initiative requires residents, landowners, foresters, arborists, nurseries, gardeners, and conservationists to work together to ensure that the correct trees are planted in the right place and managed correctly to gain the most for wildlife and people.

Tevi hope this report meets the need identified by its Canopy Cover Challenge Network participants for more guidance to inform small and medium tree planting schemes across the County. This report brings together the expertise gathered from Network participants as well as the contributing authors from Arup, Cornwall Environmental Consultants and Cornwall Wildlife Trust.

While the main body of the report provides the tree planting essentials, there is significant further information in the appendix including information on Cornwall's historic canopy cover, current regional planting schemes and local soil types.

Appendix 1: The case for Cornwall

Tree planting is currently of significant interest. The independent committee on Climate Change recommends increasing average woodland cover in the UK from 13% to 17% by 2050 to aid progress towards carbon neutrality. To achieve this, 3 billion trees need to be planted by 2050, with 1/5th of unproductive farmland converted to forest (both commercial and non-commercial), peatland or biomass and 200,000 miles of hedgerows added.

Today Cornwall has one of the lowest percentages of canopy cover of any county in the UK, approximately 9% compared to the UK average of 13%. However, this was not always the case. Research shows that Cornwall would once have had significant woodland cover, remnants of which remain today in the county's woods, parks, farmland trees and hedgerows which are important aspects of this county's famously ancient landscape (Herring 2020).

Cornwall Council, in recognition of the environmental, social and economic benefits of trees launched the Forest for Cornwall initiative in 2019. Its aim is to encourage and facilitate the planting of 8,000 hectares of trees and woodland across the county. This expansion of woodland cover would capture 38,000 tonnes of carbon dioxide a year and sequester an additional 1% of Cornwall's greenhouse gas emissions.

Analysis of ancient pollen samples has revealed that oak and hazel dominated the landscape and elm was a locally important tree species (Herring 2020). Evidence also suggests that trees grew in most places, except on cliff tops and exposed moorland peaks (Herring 2020).

Records suggests that agricultural cultivation by Neolithic and Bronze age people in Cornwall significantly reduced the tree cover, indeed, by 1000 BC the lowland landscape likely resembled our modern-day rural farmland (Herring 2020). Wooded areas would have been confined to steep valleys and sheltering corridors and hedgerows around farmland.

Records from the medieval era show the first indications of woodland management, with recordings of pollarding, coppicing, and stubbing woodland (Herring 2020). This transition to managing woodland was likely due to tenants possessing the rights to timber and wood for construction, fuel and fencing (Herring 2020).

From the 12th century deer parks were created, with at least 75 in Cornwall, covering up to 3% of the land (Herring 2020). The popularity of deer hunting within the aristocracy led to a period of canopy cover expansion up to the late 19th century alongside the establishment of many landscaped parks (Herring 2020). Most of these parks would have planted trees as decorative elements within their design which triggered a rapid growth in the planting of non-natives, which were suited to Cornwall's mild climate. However, between the late 19th century and the early 20th century virtually all of these parks were changed to arable land (Herring 2020).

From the 16th century, the expansion of deep mining drove further deforestation because timber was used to build and reinforce mine shafts (Menneer 2007). Increased demand for wood charcoal, which was the main fuel for tin smelting, also contributed to deforestation at this time (Menneer 2007). These twin pressures drastically increased demand for timber and wood, subsequently reducing the canopy cover of Cornwall.

Since the early 1900s, large plantations have increased the tree cover in Cornwall and woodland has been restored to an extent within other habitats. Most plantations were of oak, a hardy species able to withstand the Cornish elements, and produced for construction and leather tannin from the bark (Herring 2020). Ash, elm, and beech plantations were also created.

Appendix 2: Cornwall Planting Schemes

In an effort to improve the percentage of woodland cover in Cornwall a number of tree planting schemes and initiatives have been created, most notably Cornwall Council's Forest for Cornwall project which is a flagship initiative within Cornwall Council's Carbon Neutral Action Plan and part of Cornwall's Environmental Growth Strategy (Forest for Cornwall Programme - Grow Nature, 2020).

Cornwall's Environmental Growth Strategy 2015-2065

On 2nd December 2016 Cornwall Council launched its Environmental Growth Strategy which aims to ensure that Cornwall's environment will be naturally diverse, beautiful and healthy, supporting a thriving society, prosperous economy and abundance of wildlife, by 2065.

A first of its kind, the strategy works to encourage businesses, communities and individuals to collaborate to increase environmental, economic and social prosperity in Cornwall and Isles of Scilly.

A refresh of this strategy was approved by Cornwall Council on 23rd February 2021.

https://www.cornwall.gov.uk/media/24212257/environmental-growth-strategy_jan17_proof.pdf

Cornwall Council Carbon Neutral Action Plan

On 22nd January 2019, Cornwall Council declared a climate emergency and as part of efforts to reduce Carbon emissions, Cornwall is working to be carbon neutral by 2030.

https://www.cornwall.gov.uk/environment-and-planning/climate-emergency/our-action-plan/

Cornwall Council's 'Forest for Cornwall' initiative is a major part of the council's plan to become carbon neutral by increasing the carbon sequestering of Cornish woodlands. Currently there are around 32,000 hectares of woodland covering approximately 9% of land. The initiative aims to plant 10 million trees in Cornwall to form an additional 8,000 hectares and increase canopy cover by 2%.

Green Ribs project

Tree planting has also taken place in early 2020 as part of Green Ribs Project, under the "Keyn Glas" (green ridge in Cornish) programme that was funded by Highways England's Environmental Designated Funds.

The principle of the Green Ribs was based on connecting isolated woodlands with new trees, orchards and hedges to create continuous green corridors for wildlife, whilst also improving the aesthetic and cultural character of the landscape and providing benefits for the local community.

The location of the Green Ribs and associated interventions were based on a feasibility study commissioned by Highways England and led by Over Arup & Partners Ltd in collaboration with the Cornwall Wildlife Trust, and were further developed by working closely with stakeholders, local farmers and communities. Green Ribs has played a vital role in tackling habitat fragmentation, increasing ecosystem resilience and reducing vulnerability to natural disaster risks. They were also key in achieving net habitat gain and spatial connectivity across the site.

Nature Recovery Networks

On the 14th August 2020 Cornwall was chosen by the government as one of five pilot projects to help kick start the recovery of wildlife and nature across England. Cornwall Council will receive a share of a £1m fund to launch a Local Nature Recovery Strategy to map the most valuable sites for wildlife and identify areas where nature can be restored.

This could see the creation of more wildflower habitats for pollinators, additional green amenity spaces for residents and new woodlands, building on the Council's ambitious plans to plant the 8,000-hectare Forest for Cornwall over the next decade.

https://www.cornwall.gov.uk/council-and-democracy/council-news-room/media-releases/news-from-2020/news-from-august-2020/cornwall-to-play-national-role-in-recovery-of-england-s-nature-and-wildlife/

Appendix 3: Common Tree species in Cornwall

Table 5 – A reference table for key characteristics, planting/growing requirements, human use, ecological value, and disease/risk:

Tree Species	Characteristics	Planting/growing requirements	Human Use	Ecological Value	Disease/Risk	Notes
Common beech *(Fagus sylvatica)* *Native (UK)*	Can grow to 40m, typically 25-35m Wide and dense canopy spread Long lifespan Strong timber but less durable than Oak Lime green leaves with silky hair Wind pollinated	Lowland non-calcareous soil, including clay, brown earth and iron pans Lowland calcareous soil, including shallow, free-draining rocks, chalk and limestone Upland valleys Beech can be planted in dry soil, areas with high wind exposure, lime-rich soil and dry acid soil Beech should not be planted in frost pockets	Used in furniture Used as pilings due to water resistance Used for fuel – wood burns well, traditionally used to smoke herring Nuts are edible Popular hedging plant	Beech foliage is eaten by the caterpillars of moths, including the barred hook-tip, clay triple-lines and olive crescent. The seeds are eaten by mice, voles, squirrels and birds.	Beech bark disease – caused by sap-sucking scale insect Cryptococcus fagisuga and canker fungus Nectria coccinea Vulnerable to bark stripping by squirrels	An introduced species (considered native in SE England and SEWales) that has since become a dominant species across the UK. Faw is Cornish for Beech – Fowey named after the beech that grows along the estuary

Tree Species	Characteristics	Planting/growing requirements	Human Use	Ecological Value	Disease/Risk	Notes
Birch *(Betula spp.)* **Silver birch** *(Betula pendula)* *Native (Cornwall)* **Downy birch** *(Betula pubescens)* *Native (Cornwall)*	Relatively short-lived Most common tree species in the UK Fast colonisers **Silver birch:** Silver-white bark Can grow to 30m Light open canopy Bark sheds Triangular leaves Produces yellow catkins Wind pollinated **Downy birch:** Grows furthest North of any broad-leaved species 30m tall Light canopy Downy leaf stalks Produce catkins Wind pollinated Grow throughout Europe	Tolerant to a range of temperatures, thrives in dry woodland and heaths. Lowland non-calcareous soil, including sand and iron pans Upland plateau Downy birch can be planted in wet habitat, at high altitude, in frost pockets, in areas exposed to wind or in wet acidic soil. Silver birch can be planted in dry soil, in frost pockets, in areas exposed to wind or in dry acidic soil.	Birch wood is tough and heavy Used in furniture Herbal medicines Bark used for tanning leather	Silver birch leaves are a food plant for the caterpillars of many moths, including the angle-shades, buff tip, pebble hook-tip, and Kentish glory. Birch trees are particularly associated with specific fungi, including fly agaric, woolly milk cap, birch milk cap, birch brittlegill, birch knight, chanterelle and the birch polypore (razor strop). seeds are eaten by siskins, greenfinches and redpolls.	Birch dieback – caused by two fungal pathogens Marssonina betulae and Anisogramma virgultorum. Planted birch is more susceptible than naturally regenerated birch and the pathogens affect trees under environmental stressors.	Most common species in the UK One of first tree species to colonise the UK after last Ice Age

Tree Species	Characteristics	Planting/growing requirements	Human Use	Ecological Value	Disease/Risk	Notes
Common Hazel *(Corylus avellane) Native (Cornwall)*	Can grow to 12m Can live for several hundred years Oval shaped leaves Very bendy stems that can be knotted or twisted Produces catkins and edible hazel nuts	Hazel should be regularly coppiced to increase its growth Hazel is tolerant to a wide range of soils from calcareous to acid. Prefers well-drained soil with low nutrient levels.	Used in thatching Furniture production Edible hazel nuts	Hazelnuts are a key food source for hazel dormouse, but are also eaten by woodpeckers, nuthatches, tits, wood pigeons, jays and small mammals. Hazel leaves provide food for the caterpillars of moths, including the large emerald, small white wave, barred umber and nut-tree tussock. In managed woodland where hazel is coppiced, the open, wildflower-rich habitat supports species of butterfly, particularly fritillaries. Coppiced hazel also provides shelter for ground-nesting birds, such as the nightingale, nightjar, yellowhammer and willow warbler.		Hazel nuts are eaten by many species including humans and hazel dormice.

Tree Species	Characteristics	Planting/growing requirements	Human Use	Ecological Value	Disease/Risk
Elm *(Ulmus sp.)*	Elm copes very well with water Can grow up to 30m tall Lives for more than 100 years There are four species of elm in the UK: **wych elm, field elm, English elm, and Huntingdon elm. All 4 are Native (Cornwall**) **Wych elm** (Ulmus glabra): Only true native elm species in the UK but very rare now due to Dutch elm disease. Found on rocky hilly woodlands. **Field elm** (Ulmus minor): An ancient introduction to the UK from Europe. More resistant to Dutch elm disease due to its fast growth rates. **English elm** (Ulmus procera): Introduced to the UK in the Bronze age. Species has faced extreme declines due to Dutch elm disease and is now found mostly in hedgerows and in some woodland. **Huntingdon elm** (Ulmus x hollandica 'vegeta'): a hybrid from Wych and Field elm designed to resist Dutch elm disease. Cultivated in 1746 by nurserymen Wood & Ingram. Was widely planted in the UK in the 1930's and is very common.	English elm grows best in well-drainage soil in hedgerows and woodland. Tolerant to soils with a range of pH levels Wych elm grows beside streams or in hilly or rocky woodland. Very hardy tree species Field elm and Huntingdon elm species are hardy and common in most environments – cope with range of pH soils.	Traditionally used to create troughs, drains, pumps, coffins and pilings for buildings Used as slow burning fuel	Many birds and some small mammals eat elm seeds and the leaves provide food for the caterpillars of many moths, including the peppered, light emerald and white-spotted pinion moths. Caterpillars of the white-letter hairstreak butterfly feed on elms and the species has declined dramatically since Dutch elm disease arrived in the UK.	Dutch elm disease – Killed over 60 million trees since the 1960s and is spreading Northwards. Most of the UK has been affected. The disease is caused by a fungus (Ophiostoma novo-ulmi) which is spread by the elm bark beetle (Hylurgopinus rufipes).

Tree Species	Characteristics	Planting/growing requirements	Human Use	Ecological Value	Disease/Risk	Notes
European Ash *Fraxinus excelsior) Native (Cornwall)*	Traditionally thought of as the wood of farmers, a tough but elastic wood Can live for 400 years One of most common tree species in the UK Grows to 35m, often grow together forming dense canopies Pollinated by wind	Can grow in lowland non-calcareous habitat with brown/red soil. Lowland calcareous habitat with free-draining shallow soil, chalk and limestone, clay vales. Upland valleys with brown earth. Ash is very resilient – can be planted in wet soil, dry soil, at high altitudes, in frost pockets, high wind exposure, near to the sea, lime-rich soil and wet or dry acidic soil.	Used as fencing, tool making and sports equipment, furniture and is a very good domestic fuel One of toughest hardwoods – absorbs shocks without splintering Immature seeds are edible and have been used in herbal medicine	Bullfinches eat the seeds and woodpeckers, owls, redstarts and nuthatches use the trees for nesting. Because the trees are so long lived, they support deadwood specialists such as the lesser stag beetle. The leaves are an important food plant for the caterpillars of many species of moth, including the coronet, brick, centre-barred sallow and privet hawk-moth.	Ash dieback (Hymenoscyphus fraxineus) – may kill up to 95% of the UK population. Ash dieback is a fungus that originally came from Asia, but has now spread throughout the UK and is killing native ash. The effects of ash dieback are predicted to cost £15 billion in the UK.	One of the most common trees in the UK.
Hawthorn *(Crataegus spp.)*	A hedgerow staple species that blossoms in May. Can grow to 15m tall Dense, thorny habitat Pollinated by insects Two species in the UK – **Common hawthorn** (Crataegus monogyna) Native (Cornwall) and **Midland hawthorn** (Crataegus laevigata). Native (UK). The two species often hybridise.	Can be planted in dry soil, in sites with high wind exposure, near to the sea, in lime-rich soil or acidic dry soil.	Often used in engraving and is good firewood and makes charcoal with a high burning point. Young leaves, flowers and flower buds are edible Often used as a hedging plant	Valuable food source for many small birds and insects, including thrushes, hawthorn shield bugs and yellowhammers. The dense thickets also provide shelter for small mammals such as wood mice and hazel dormice, and are used by birds as nesting sites.		

Tree Species	Characteristics	Planting/growing requirements	Human Use	Ecological Value	Disease/Risk	Notes
Lime *(Tilia spp.)* *All 3 species are Native (UK)*	Grows to 20m high Three species in the UK – **small-leaved lime** (Tilia cordata), **large-leaved lime** (Tilia platphyllos) and **common lime** (Tilia x europaea) which is a hybrid of the two. Small-leaved lime is an indicator of ancient woodland – once a common species, now fairly rare	Can grow in Lowland non-calcareous habitat with iron pans. Can grow in lowland calcareous habitat with soft mineral soil, alkaline gleys and pelosols. Can be planted in sites with high wind exposure and in lime-rich soil	Lime has been traditionally used for carving for centuries in Cornwall, particularly for making musical instruments. Its beaten bark was also used in rope making in Cornwall. Flowers can be used to make tea The sap is used to make wine	Lime leaves are eaten by the caterpillars of many moth species, including the lime hawk, peppered, vapourer, triangle and scarce hook-tip moths. They are very attractive to aphids, providing a source of food for their predators, including hoverflies, ladybirds and many species of bird. The flowers provide nectar and pollen for insects, particularly bees.	Aphids – infestations of aphids are common on limes	One of the dominant species when trees colonised the UK after the Last Ice Age but not common in Cornwall

Tree Species	Characteristics	Planting/growing requirements	Human Use	Ecological Value	Disease/Risk	Notes
Oak *(Quercus spp.)*	A very strong and durable hardwood Large deciduous tree – grows 20-40m tall Forms a broad canopy Can live for 1000 years, with most living 150-250 years Several species found in the UK: **English oak** (Quercus robur) Native (Cornwall)– supports more biodiversity than any other native tree species. Second most common species in the UK **Sessile oak** (Quercus petraea), Native (Cornwall) **Holm oak** (Quercus ilex) – non-native introduced in 1500s. Broad-leaved with evergreen leaves **Turkey oak** (Quercus cerris) – non-native introduced in 1700s and host to the gall wasp Andricus quercuscalicis, whose larvae damage the native British oak acorns. Acorns are distinctive and hairy	Can grow in lowland non-calcareous habitat with iron pan, brown/red soils or soft mineral soils. Lowland calcareous habitat with heavy well-drained alkaline clay and brown soil or soft mineral alkaline gleys and pelosols. Upland habitat with brown earths. Sessile oak can be planted in wet soil, dry soil, at high altitudes, in sites with high wind exposure, in wet and dry acidic soil. English oak can be planted at high altitude, or in wet acidic soil Holm oak is resistant to salt and is often planted as windbreaks along the Southern coastline.	Oak has long been valued and used by people living in Britain One of the hardiest and durable timbers in the world – takes over 150 years for an oak to mature for felling The tannins in its bark was used to tan leather by the Romans. Ink was made from gall balls from gall wasps Leaves and acorns used as medicinal ingredients Often planted in urban environments to support wildlife and create shade and decrease urban temperatures.	Oak is especially valuable ecologically – it has been recorded as supporting the greatest biodiversity of any tree species. In autumn, mammals such as squirrels, badgers and deer feed on acorns. Flower and leaf buds of English oak are the food plants of the caterpillars of purple hairstreak butterflies. Bats also roost in old woodpecker holes or under loose bark, as well as feeding on the rich supply of insects in the tree canopy.	Acute oak decline – the decline of mature oaks due to environmental stress resulting from disease, pollution, pests, and flooding that make the tree more susceptible to insects, fungi, and bacteria. Oak processionary moths (Thaumetopoea processionea) – a non-native pest found in greater London, Surrey, and Berkshire. The moth damages the leaves and increases the oak's susceptibility to disease. Also, the moth's hairs are toxic and can be harmful to humans.	The second most common tree species in the UK

Tree Species	Characteristics	Planting/growing requirements	Human Use	Ecological Value	Disease/Risk	Notes
Sycamore *(Acer pseudoplatanus): Non-native*	Non-native in the UK, introduced in 1500s Broad-leaved species Grow to 35m tall Live for 400 years Pollinated by wind and insect to form winged fruit Seed is very fertile, colonise areas easily	Mature trees are very tolerant so are often planted in highly exposed and coastal areas as a windbreak. Sycamore is also highly tolerant of pollution so are planted in urban environments such as along streets.	Sycamore timber is hard and strong and is used to make furniture. Mature trees are very tolerant of wind and salt so planted along coast	Sycamore is attractive to aphids and therefore a variety of their predators, such as ladybirds, hoverflies and birds. The leaves are eaten by caterpillars of a number of moths, including the sycamore moth, plumed prominent and maple prominent. The flowers provide a good source of pollen and nectar for bees and other insects, and the seeds are eaten by birds and small mammals.	Sooty bark – the fungus Cryptostroma corticale causes the disease in maple, although sycamore is particularly vulnerable. The disease can be fatal to the tree and can cause pneumonitis in humans.	Introduced to the UK in Tudor times and was a popular choice in estate gardens and landscapes

Trees have been defined as Native (Cornwall), Native (UK) and Non-native. Native (UK) are species that while native in the UK are considered to be introduced in Cornwall:

- Alder (Alnus glutinosa) Native (Cornwall)
- Elder (Sambucus nigra) Native (Cornwall)
- Blackthorn (Prunus spinosa) Native (Cornwall)
- Rowan (Sorbus aucuparia) Native (Cornwall)
- Holly (Ilex aquifolium) Native (Cornwall)
- Spindle (Euonymus europaeus) Native (Cornwall)
- Wild cherry (Prunus avium) Native (Cornwall)
- Scots pine (Pinus sylvetris) Native (UK)

Appendix 4: Cornwall planting limitations

Whilst it is important to increase tree cover, there are many protected habitats in Cornwall that should not be built on and other habitats that are unsuitable to support woodland.

These sites are those that should not have tree planting on because they hold environmental or cultural significance:

- Protected sites with range species
- Archaeological sites
- Unploughed grassland
- Wetlands
- Heathland

Outside of these no-plant areas, there are a number of factors that can limit tree planting.

Geology of Cornwall:

The rock that lies beneath the soil influences which tree species can be planted. The geology of Cornwall is dominated by Devonian sandstone and slate and has granite running under its interior, although the North East region possesses carboniferous sandstone and shale and the Lizard peninsula is mostly serpentinite.

The **granite bedrock** areas of Cornwall form the upland habitats that stretch from East to West. The granite intrusions have lifted the ground, making the land very exposed and the solid bedrock makes the land infertile. These upland habitats support moorland which is dominated by moss, gorse, and heather, but contains few trees. Woodland is unable to grow on the granite areas due to the limited and poor topsoil and the high levels of exposure to wind and environmental conditions.

The **Devonian sandstone and slate** areas are far more fertile and would have once supported vast woodland but now mostly support agricultural farmland. The sheltered south coast has more wooded areas, particularly in valleys with rivers and streams.

The Lizard peninsula is an ophiolite formed of an uplifting oceanic crust containing mostly **serpentinite** rock which is infertile. This area supports grassland and marshy heaths, with few trees.

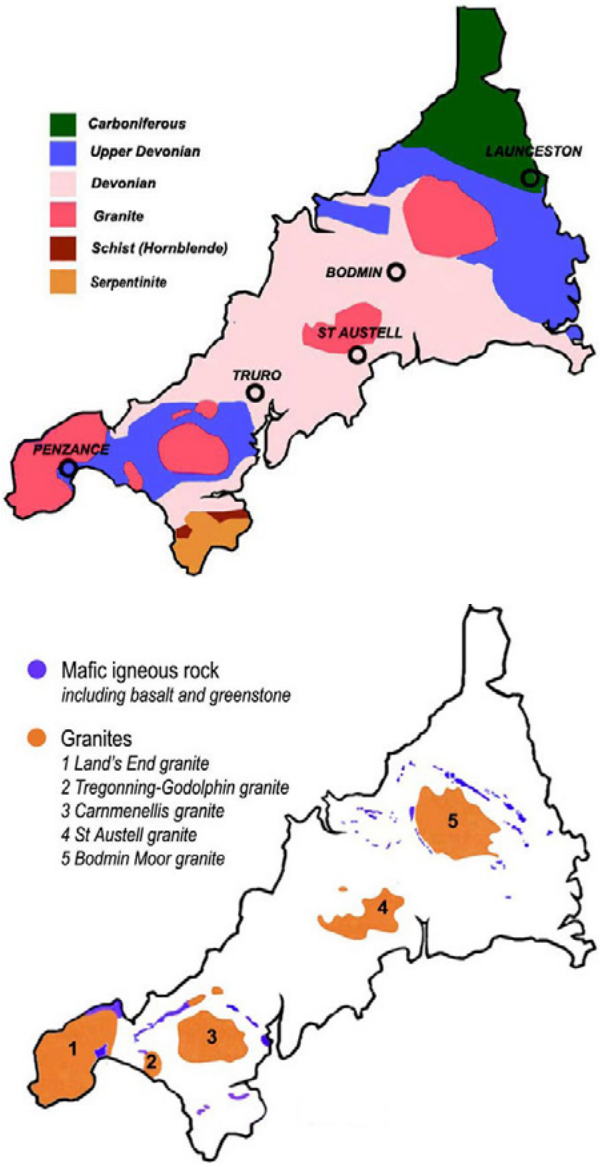

Image 5. The geology of Cornwall – dominant rock form and sites of interest. Source: Wikipedia

Climate:

The climate in Cornwall is classified as Temperate Oceanic (Koppen climate Cfb), consisting of mild winters and cool summers. The Gulf Stream ensures that Cornwall is the mildest and sunniest county in the UK, and the lack of frost enables the county to grow tropical plants that would struggle elsewhere in the UK.

Exposure:

The Cornish coastline is highly exposed to prevailing wind and to salt, which make a harsh environment for many plant species. The North coast is more exposed than the South and has high and steep cliffs, with only one large river estuary, The Camel. The south is more sheltered and includes several large and sheltered river estuaries.

Habitat types

Cornwall possesses a wide range of habitat types that differ in suitability for tree planting.

Coastal:

Cliffs with shallow, dry soil and shale rocks.

Few tree species can grow in these environments. Salt and wind tolerant tree species include: Common Alder (Alnus glutinosa), Common dogwood (Cornus sanuinea), Hazel (Corylus avellana), Common Hawthorn (Crataegus monogyna), Osier Willow (Salix viminalis), Rowan (Sorbus acucparia).

Farmland:

Arable or pastoral land is typically chosen as it is highly fertile and can support many different types of plants. Often landowners will choose tree species than can support their grazers by providing shade and shelter and nutrients

Farmland is also suited to a remerging style of farming called 'Agroforestry', which involves growing trees and agricultural/horticultural crops on the same land. Agroforestry is recognised for its diversity of production, as well as its role in improving soil quality, preserving nature, and reducing carbon outputs.

Grassland:

Dominated with grass cover but are often home to a wide variety of plant species, including some tree species.

Grassland covers around 40% of the UK – most grassland is used for grazing and agriculture, with very few 'unimproved' areas remaining (areas that have never been ploughed, reseeded or fertilised). Unimproved grassland should not be planted on without seeking advice beforehand.

Heathland & Moorland:

Gorse, heather, and moss dominate these habitats. Very few trees can grow here as they are highly exposed to the elements. Species may establish in more sheltered areas. On the whole these two habitats should not be selected for tree planting because of their unique ecological importance.

Rocky habitat:

Found within the upland moors in Cornwall. Very little can grow in these environments, usually only small plants grow out of crevices and ledges. Pine trees and oak can colonise rocky outcrops, but planting is very difficult and carries a high risk of failure.

Urban:

A huge variety of species are found in urban habitats as people like to plant a range of species and can provide the habitat needed for species that would be unable to grow in the wild. Trees in urban areas are found in gardens, streetscapes and in parks.

Brownfield:

Planting on urban brownfield sites tends to focus on parks or street lined planting which are more managed and ordered.

Mining sites pose an interesting brownfield planting opportunity. Many coal mines have been planted in the UK, including Mead in Derbyshire which will have 250,000 trees planted to create a woodland within the next decade. In Cornwall, Imerys has done some similar work around the St Austell area.

Wetlands:

Wetlands such as lakes, rivers, bogs, floodplain meadows and marshes are either permanently or seasonally flooded due to the landform and soil type, so species must be adapted to wet environments. Tree species that thrive in wetlands include alder, willow, and birch. On the whole this habitat should not be selected for tree planting because of its unique ecological importance.

Woodland:

Existing woodland provides ideal habitat to build on existing woodland or to expand its borders. In these instances it's important to plant species that are commonly found in the local area because these will be well suited to the environment

Wood Pasture & Parkland:

Often a mix of habitats due to historical landscaping and management, including scrub, denser woodland groves, open grassland, or heathland with sparsely planted trees.

This is an ideal habitat to plant trees, but guards must be used to protect from over-grazing. These are mosaic habitats valued for their trees, especially veteran and ancient trees, and the plants and animals that they support, particularly insects, lichens and fungi which depend on dead and decaying wood. Grazing animals are fundamental to the existence of this habitat.

Orchards:

As well as fruit production, orchards can also provide biodiversity and landscape character enhancements and positively contribute to local distinctiveness across Cornwall. Furthermore, orchards can support farm diversification and traditional craft opportunities.

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Photo by: @pakhnyushchyy

Publication date:

May 2021

Contributors:

Thanks to all the participants in this Tevi Challenge Network for sharing their knowledge and experience for inclusion within this report in order to inform future tree planting activitiy in the county.
Thanks also to Cornwall Environmental Consultants for providing an expert review to ensure the content is up to date and aligns with best practice.

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