UNDERSTANDING TREES

To appreciate the indispensable value of trees it's worth understanding some basic tree-related information … starting with answers to these questions: what is a tree?; where do trees come from?; how do trees live?; and why are trees important? Here's a quick simplified overview. If some words or terms are unfamiliar, there are explanations in the Glossary.

Trees have ancestral lineages

Trees are complex living organisms. The earliest vascular plants are known to have existed ±420-million years ago (mya) in the Silurian period (approximately 443-419mya) – arising from primeval non-vascular spore-bearing bryophyte and pteridophyte plants with origins reaching back to around to a time 500mya. Throughout the mid-Devonian era (approximately 392-382mya) vascular plants developed in size and dimensions into upright proto-tree types which, over the next 350mya evolved chemically, morphologically, physically and physiologically into today's recognisable tree species – firstly, as cone/seed-bearing conifers and then, as flower/seed-bearing broadleaves. Enormous diversity and variation is apparent, even to the casual observer. Since the earliest days of a primordial world photosynthesising cells developed and diversified into a multitude of forms, to the point where modern-day trees epitomise biological and botanical sophistication. Evolution continues.

Together with an amazingly diverse range of other plants seed-bearing trees belong to an all-encompassing assembly – Kingdom Plantae, as botanists refer to it (simply outlined in Appendix 3: Plant Nomenclature/Tree Identification). Taxonomically, with an emphasis upon reproductive structures and strategies, plants are classified and distinguished from other living organisms by a suite of shared biological and botanical characteristics and features – so that despite wide-ranging differences in appearance, shape and size they can be precisely categorised, collectively yet separately, from the kingdoms of animals (Kingdom Animalia), fungi (Kingdom Fungi) and simple or single-celled organisms (Kingdoms Protista and Monera).

Botanical taxonomy – and nomenclature, the allied discipline of scientifically naming plants in accordance with a systematic hierarchy – is ever-advancing. Plant names – and how they define associations and relationships with others – change as knowledge increases. Science and technology, utilising modern DNA studies and powerful microscopy, continue to decipher and decode novel plant affiliations. Academic research and debate, accounting for differences of opinion, drives specification and is ongoing. There is still much to learn.

Trees are different

Essentially, trees differ from other types of plants (like ferns, herbs, grasses and palms) because they are 'woody'. That is, unlike herbaceous or fibrous plants, trees contain flexible but strong 'wood' (specifically, xylem cells, which contain high volumes of the organic polymers cellulose and lignin) conducting raw minerals in solution *upwards* from roots to leaves. Wood is encased within a sheath of tough, chemically-infused bark (specifically, phloem cells, similarly containing cellulose but lesser proportions of lignin) which circulate

organic sugars and substances *downwards* and *outwards* from leaves to roots, whilst simultaneously providing exterior protection. Incidentally, in a general sense, be aware phloem cells remain functionally alive whereas xylem cells are dead at maturity. Acknowledge tree (and plant) cell life and death is not entirely casual and haphazard but, instead, typically predetermined and synchronised.

Collectively, the constant inward/upward/outward circulation of basic and synthesised metabolites through the 3-D latticework of microscopic conduits of xylem and phloem (and associated companion/supporting cells) – enabling/encompassing processes of absorption, translocation, energy creation, energy release, transpiration plus photosynthate allocation, exudation and storage – supports the tree's life, whilst facilitating the continuous conversion of organic substances and chemical elements.

Trees are interconnected and integrated

Trees have aboveground and belowground parts. Both the aerial and terrestrial portions are functionally and physically interlinked. Aboveground, an upwardly extending/expanding trunk and branch system, varying in form and height, elevates the plant into space above competing and surrounding plants. Belowground, a horizontally/laterally spreading root system explores the surrounding substrate radially, far beyond the extremities of the tree's upper crown.

The cellular composition of tissues forming branches, stems/trunks and roots – composed of a biochemically interlocking matrix of strengthening cellulose and stiffening lignin (combined with other carbon-based constituents) – confers the capacity, durability and support required for a tree to develop vertical height plus sideways spread, which matures over a predetermined continuum of life stages. Different species have different lifespans. Some woody trees are the largest and longest-lived organisms in the world.

In overall terms (being 'higher' more evolved plants) woody trees bear seeds (as opposed to spores, produced in 'primitive' plants like mosses and ferns). Trees develop differentiated cells in intricately specialised arrangements. Be aware, that tree types merely referred to as 'conifers' and 'broadleaves' are ecologically, morphologically and physically *different* – they have taxonomically distinctive characteristics. Both conifers (gymnosperms, the earliest woody trees to evolve) and broadleaves (angiosperms, the more recent woody trees in evolutionary terms) are taxonomically classified according to their reproductive parts, vascular systems and a range of shared anatomical, biological and physiological attributes.

Trees are infused with exquisitely sensitive chemical co-operators, messengers and signallers that trigger both cyclic, rhythmic and spontaneous reactions. Trees are adaptive and responsive to every subtle expression of biotic life and/or abiotic influence around them. Their most remarkable ability (shared with all other plants) is the capacity to convert electro-magnetic energy (sunlight) into biochemical energy (sugar) – thereby creating their own 'food' (in various forms of organic carbohydrate) from basic ingredients (comprising a combination of water, nutrients and carbon dioxide) – through the chemically complicated process of photosynthesis.

Trees are co-evolved

Trees are intricately associated with the world around them, both above and below ground. They cycle and recycle gaseous, liquid and solid elements in ways that both create and maintain life – for themselves, for a host of dependents, for us and, in fact, for the wider world. Trees are ecosystems within ecosystems. They have intimate and inseparable relationships with fungi (many being beneficial and harmless, some being debilitating and fatal). Their collaborations with mycorrhizae enable them to tap into the complicated and vast resource-sharing network nowadays referred to as the 'wood-wide web' discussed (amongst other things) by Sheldrake, who states "*The relationships between plants and mycorrhizal fungi are key to understanding how ecosystems work*" (Sheldrake, 2020).

Trees (and all photosynthesising plants) plus fungi are *the* crucial living component within the world's biosphere. They have intimate co-operative associations, connections and partnerships with a myriad of organisms – from bacterial, viral and fungal microbes to soil microfauna and air/land/water-based megafauna – and manifestly modify the environment in which they exist. Being sedentary, trees cannot move away to avoid changes, harms or threats but, instead, employ an amazingly elaborate array of biological, chemical, morphological, physical and physiological adaptations, adjustments and defences to ensure their survival.

Many excellent technical books and references provide insightful information and offer the basis for lifelong study. It is beyond the scope or intention of this work to delve too deeply into the intricate world of tree biology and botany. The art and science of arboriculture, however, as an allied discipline, provides useful terminology and readily-used evaluation methods relevant to the trees discussed here. In this appraisal I apply a simplified evaluation of interrelated tree health, condition and longevity factors to provide comment on and summarise an individual tree's growth and development to date – and, in some few cases, indicate a timespan for their remaining future.

Trees in The Lakes

It is clear to anyone with an interest that, aside from native trees, many exotic species from the northern hemisphere temperate climate zones of Europe, Asia and America grow in Lakeland – they are apparent everywhere in gardens and landscape plantings. Also, southern hemisphere temperate zone trees, whilst less seldom seen, occasionally occur in some of the more diverse and specialised plant collections. In general, a broad range of exotic (alien) tree species are found throughout the district. Most are ornamental specimens – some are silvicultural forest timber producers – a few are pernicious environmental weeds.

Trees dispersal depends on various factors/influences

Many of Britain's native and naturalised tree species are commonly found throughout the Lake District, wherever conditions sustain them. Take care when identifying similar but distinctly different species. Trees endemic to the cooler, wetter, higher ground of northern and western England are more likely to be seen compared to their close relatives from the warmer, drier and lower areas of southern and eastern regions. For instance, consider distinguishing between sessile oak (*Quercus petraea*) and pedunculate oak (*Q. robur*), silver birch (*Betula pendula*) and downy birch (*B. pubescens*) plus bird cherry (*Prunus padus*) and

wild cherry (*P. avium*). All these species grow in Cumbria, though they are encountered more or less abundantly/infrequently depending upon variable factors like elevation, location and the intrinsic availability of conditions that suit their requirements. There are many other examples of species preference and differentiation, of course. While exceptions exist local climate, ecology and geology largely determine which wild trees thrive in the Lake District; the most common native and archaeophyte species are those particularly adapted to Cumbria's environment.

Trees acclimated to the wilder landscapes of The Lakes are suited to (if not tolerant of) variations in soil type, edaphic conditions, drainage, nutrients, pH, precipitation, temperature and windforce. These abiotic factors affect a plant's capacity to endure, seed and proliferate. Elevation above sea level is another defining influence, in that different species reach natural limits of growth at varied altitudes. Many native species are capable of living at elevations above the heights of trees seen growing these days on the Cumbrian fells (and as may be seen in Scotland, for instance) but, in Lakeland, are generally limited to the current altitudes they thrive in by browsing pressures and human activities.

Cumbria's treeline changed over millennia – initially imperceptibly and slowly, then more rapidly as permanent pastoral human populations expanded, clearing and grazing ever-enlarging areas. Such ancient and ongoing anthropic practices significantly altered the natural plant assemblies existing prior to the increasing impacts of early peoples living within the countryside. However, aside from the adverse effects of human modification of natural woodlands over time, appreciate that Lakeland's contemporary remaining/remnant wild trees are perfectly in tune with their surroundings. They are in harmony with the landscape, living and surviving unpretentiously in an environment seemingly untouched, but actually remodelled (by human activity and influence) since the late Neolithic and early Bronze Age (2,500-1,500BCE) – existing across terrain where, back in Britain's primeval history, an unbroken forest covered the majority of land in all but the highest, harshest or unfavourable places. The negative aspects of climate change and human-induced interventions/pressures will continue to threaten the trees and woodlands of Cumbria.

Overall, Lakeland's climatological, geological and topographical parameters define and limit the tree types able to withstand the prevailing bio-geophysical conditions, so that a shortlist of recurring native species is evident. This is the palette of inherent trees that naturally inhabit the valleys and fells – and provide ecological habitats, biological diversity, seasonal colour and living texture to the landscape in so many ways.

Native trees of Britain

The number of native trees found in Britain is small. Over recent years the sum of tree species considered native – comprising those present from around 9,000+ years ago (7,000BCE) following the retreat of the last major ice sheet covering most of north-western Europe's land masses combined with those confined in isolation to Britain's archipelago after the loss of the former land-bridge link with continental Europe – has been the subject of intense debate in plant botany and taxonomy circles.

A panoramic account of how Britain came to exist in its contemporary configuration is given in Nicholas Crane's illuminating geographic and human history *The Making of the British*

Landscape (Crane, 2016) – where climate and geology, sculpted by earth-shattering physical events, shaped the land whilst, over millennia, early people increasingly modified the environment through clearance, settlement and development. Crane alludes to how the original flora of Britain was discovered, utilised and ultimately reduced to its present-day distribution.

Equally so, Edward Hyams' *The Changing Face of Britain* (Hyams, 1977) traces the geological, agricultural, industrial and societal changes that cumulatively reshaped (and destroyed) so much of Britain's primary landscape – resulting in its wildwood becoming almost irrevocably diminished. Hyams' acute observations on historical movements in architecture, engineering and technology – when linked with the incessant introduction of exotic species from around the world – explains how alien plants supplanted or replaced so many native trees from their former natural woodland strongholds to become the mainstay of ever-expanding housing and suburban gardens.

Additionally, the extraordinarily informative and precise botanical works of Gabriel Hemery and Sarah Simblet's *The New Flora* (Hemery and Simblet, 2014), with Clive Stace's *New Flora of the British Isles* (Stace, 2015) and Stace, Preston and Pearman's *Hybrid Flora of the British Isles* (Stace *et al*., 2019) provide encyclopaedic details of our islands' original and introduced plants and their genetic relationships. Alan Mitchell's standard *A Field Guide The Trees of Britain and Northern Europe* (Mitchell, 1982) is a rich source of information for anyone looking to accurately identify British trees. Those wishing to gain an understanding of how trees live and their pivotal place in Nature will find insight and wisdom in Peter Thomas' erudite *Trees - Their Natural History* (Thomas, 2014).

Presently, about 60 woody plants (trees and shrubs) are recognised as native to Britain – describing species, subspecies or hybrids naturally occurring prior to post-ice-age human incursion and settlement. Until recently plant botanists and taxonomists have generally accepted only 35 native species of the proposed ±60 as certain and widespread. This agreed flora means the suite of native trees seen across today's countryside is modest. Their natural distribution is primarily influenced by climate, geology and intrinsic natural dispersal parameters, with only some of that number found locally throughout Lakeland. Within today's ±60 documented natives the majority are angiosperm (broadleaf) species – with just three gymnosperm (conifer) trees: common juniper (*Juniperus communis*), Scots pine (*Pinus sylvestris*) and European yew (*Taxus baccata*).

Taxonomic studies will undoubtedly rewrite our understanding of Britain's flora. An extended list of species is a likely outcome. Ongoing natural variation and hybridisation is evident in several genera – such as, for example, in *Ulmus* and, particularly, within the rich and locally adaptable *Sorbus* (currently representing 17 of the ±60 British native trees acknowledged).

Atlantic forest species

Broadly speaking, global vegetation zones are defined by similarities in climate, geology and naturally occurring plant assemblies/communities. In simplistic terms the Atlantic forest zone forms a European ecoregion incorporating plant species with shared floristic associations and characteristics, ranging over neighbouring countries.

The main vegetation types across Europe are indicated in Figure 1.

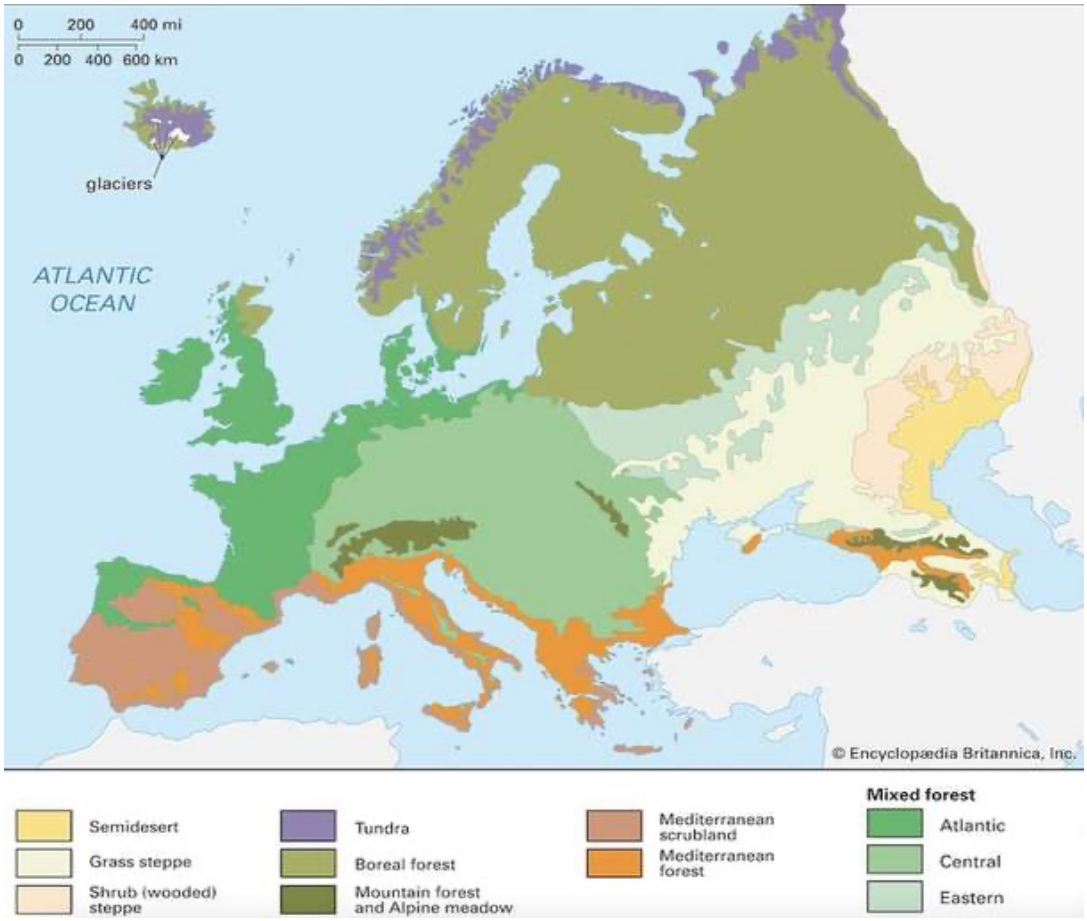

Figure 1: map of vegetation zones of Europe
Britain in relation to neighbouring ecoregions, indicating its shared associations with species nominated as Atlantic mixed forest and, to a lesser extent, boreal forest.
See Bibliography: Britannica, 2024.

Nowadays, in Britain, few areas of original Atlantic mixed forest remain intact, due to changes in human settlement, agriculture and land-use development over past millennia.

Following the withdrawal of the last ice sheets from the frozen northern limits of (what we now know as) Europe (throughout the period approximately 10,000-8,000 years ago) the land rebounded across large areas. The dispersal, establishment and survival of tree (and other plant) species progressed north-westwards, at differing rates and over centuries, as the ice retreated. Tree species gradually spread across the cool, wet, defrosted out-lands following the slow thaw. A once much larger north-western landmass was exposed, affording almost continuous forest from today's central Europe to the treeline of the Arctic Circle – a vast cold wilderness with so few people their presence was barely noticeable.

An island outline emerged from the forming north-western landmass, as land recoiled and uplifted, freed from the burden of thick ice. Rising sea levels changed coastlines, bringing deep and permanent inundation from ice-melt over once-buried strata. This early 'Britain' contained tree species occupying the most north-westerly edge of the European continent's cool temperate region. Species connected over distance formed unbroken woodlands –

assisting or barring the distribution of plant competitors, depending upon their capacity to either live co-operatively or to form exclusive mutual monocultures.

Britain's flora established during the early-mid Mesolithic period (10,000-8,000BCE) due to geographic transformation and isolation, because of dynamic post-glacial change across Europe's wider far north-western landmass. A now lost, extensive, eastern low-lying expanse of land (formerly known as Doggerland, reduced in size to Dogger Hills and then latterly Dogger Island) located off Britain's then eastern coastline (occupying the area now known as the North Sea, approximately between contemporary England, Scotland, France, Belgium, the Netherlands and Norway) was, over time, repeatedly inundated by rising seawater levels. Meltwater gradually overwhelmed Doggerland.

Research indicates the last remnants of Doggerland were ultimately smashed by a devastating tsunami – generated (controversially) by the Storegga submarine landslides emanating from a massive coastline collapse off Norway's underwater continental shelf – and finally succumbed to flooding, erosion and scouring on a huge scale. Around 5000BCE the expanse of the then northern sea joined with the larger south-western ocean. Saltwater poured and flushed in accordance with the tides, cutting and raking through 'England's' eastern and southern coastal sands and muds – and inexorably drowning the land-bridge that previously connected the north-western region of 'Britain' from the continental landmass we know today as Europe, Scandinavia and beyond. Early Britain became an island archipelago. Separated by a wide tidal channel only those tree (and plant) species existing north of the deep watery divide came, in our modern world, to be regarded as native to the British Isles.

Trees are everywhere – but don't necessarily originate from nearby

Numerous trees someone may casually consider native and normal in the British countryside are, perhaps surprisingly, exotic denizens from Europe, the Mediterranean, Scandinavia, North America, Asia and elsewhere. For instance, frequently seen broadleaves including sycamore (*Acer pseudoplatanus*), horse chestnut (*Aesculus hippocastanum*), sweet chestnut (*Castanea sativa*), walnut (*Juglans regia*), London plane (*Platanus* x *hispanica*), robinia (*Robinia pseudoacacia*), field elm (*Ulmus minor* 'Atinia' and Turkey oak (*Quercus cerris*) – plus conifers such as noble fir (*Abies procera*), Lawson cypress (*Chamaecyparis lawsoniana*), European larch (*Larix decidua*), Norway spruce (*Picea abies*), Douglas fir (*Pseudotsuga menziesii*) and many others – whilst familiar and common, originate from beyond Britain's shores.

People transformed Britain. At first, in the earliest ages, signs of change were imperceptible, small-scale and restrained. Gradually the extent of modification and rate of conversion ever-rapidly reshaped the environment to the anthropomorphic form we inhabit today. The extent and pattern of human settlement, a rising population and advances in knowledge, skills and technology exerted increasing pressure on the countryside. Adopting indicative anthropological timescales, it is known that throughout the Mesolithic period (10,000-6,500BCE) nomadic hunter-gatherers roamed an emerging post-glacial landscape. Over subsequent millennia the following Neolithic period (6,500-4,000BCE) and then Bronze Age (3,000-1,000BCE) saw people forming small but settled communities where simple farming became established practice.

Human activity reformed, drained and developed the land. Native woodlands provided plentiful resources – essential timber, fodder, fruit, game and abundant materials with limitless uses. Human commerce, endeavour and trade connected Britain with remote places, enabling both the intentional and unforeseen introduction of tree species from near and far – imported as food and fibre, as items of scientific interest and wonder and, from the 1700's onwards, as status symbols that graced many grand gardens, display houses and parklands. Over a long time, but before anyone realised, the British Isles became a botanical potpourri – wherein a mixed native and exotic forest and garden medley containing both desirable and weedy species, spread over the entire island country.

Tree and forest relics – rarest of the rare

Therefore, as indicated, whilst temperate Britain provides the setting for an extraordinary array of trees, inhabiting a wide range of sites, only a small number are taxonomically described as native. Archaeophytes and introduced or naturalised trees plus exotics from around the world have expanded the spectrum of well-known species so that, to a casual observer, it would seem Britain's flora is vastly more extensive than is the case.

The country's tree-rich estates and remaining woods are beautiful and important, though seldom botanically and taxonomically pure and unchanged from former times. In reality, truly aged and original native woodland is greatly diminished and now hard to find.

Some isolated tracts of semi-ancient native woodlands exist throughout Britain, dispersed and threatened – a vestige of earlier wildwood days. They are precious, an indication of the seemingly unbroken primeval forests that once covered most of the country from coast-to-coast – special indeed, when compared to the more 'modern' copses, woods, urban treescapes and production plantations to emerge from the agricultural, industrial and societal revolutions following the 18th century.

All semi-ancient sites are valuable, of course – however, those at higher elevations along Britain's western ramparts are especially enthralling, since they represent the last remains to be found of primal woodlands referred to as 'temperate rainforest'.

The Lake District has a few such sites – most notably Young Wood, near Mungrisedale, briefly described in the notes for *5.2 Bannerdale Crags 6* and *10 (BOOK FIVE)* and defined by Dr Andrew Weatherall as "*the highest Atlantic oakwood in England*" (Weatherall *et al*., 2012). Botanically and ecologically Young Wood is an exceptionally rare and exciting remnant of what was once widespread upland oakwood. Guy Shrubsole also chronicles Cumbria's Young Wood, alongside two other similar 'Atlantic oakwood' sites (located in Borrowdale) – plus many other intriguing "*temperate rainforests*" found along Britain's western/northern fringes – in his comprehensive survey *The Lost Rainforests of Britain* (Shrubsole, 2022). All of Britain's 'temperate rainforest' sites are incredibly valuable and fragile. It should be hoped that ongoing conservation, replanting and rewilding efforts, supported by policy and protection, will ensure an increasing area of Britain's native forests, natural environments and wild ecosystems are preserved and perpetuated.