

Fagus sylvatica in Europe: distribution, habitat, usage and threats

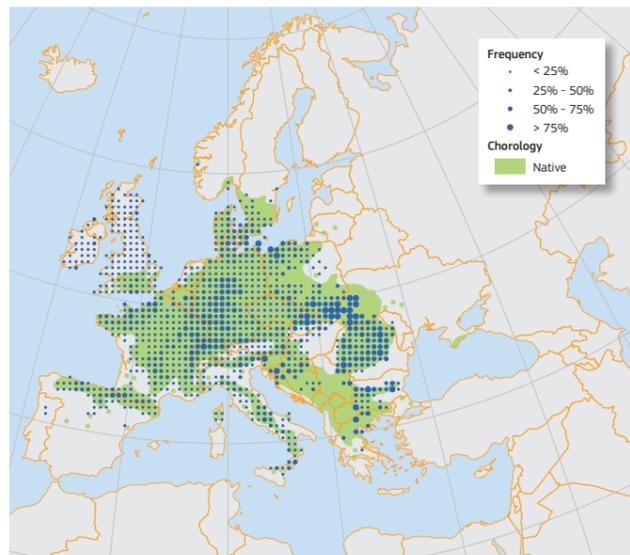
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Fagus sylvatica L., or European beech, is one of the most important and widespread broadleaved trees in Europe. It is a large deciduous tree that can maintain its high growth rate until late maturity. Its natural range extends from southern Scandinavia to Sicily, from Spain in the west to northwest Turkey in the east. Though not demanding of soil type, beech requires a humid atmosphere with precipitation well distributed throughout the year and a well-drained soil. It tolerates rigorous winter cold, but is sensitive to spring frost. Owing to the capacity of its root system for assisting in the circulation of air throughout the soil, and the amount of potash in its leaves, Beech trees conserve the productive capacity of the soil better than many other species. Its wood is strong and wears well making it ideal for a wide range of uses, from furniture to musical instruments, as well as for pulp and firewood.

The European beech (*Fagus sylvatica* L.) is a large deciduous tree that commonly reaches 30-40m and is capable of attaining heights up to 50m in some locations¹. In contrast to many other tree species, it is able to maintain a high rate of growth until a relatively mature age. The tree is usually single-stemmed with silver-grey bark. The leaves are typically 10 × 7 cm, dark and shiny green. They have an oval to elliptic shape, with wavy margins and short teeth at the end of the parallel veins on each side^{2,3}. Beech is **monoecious**: the male and female flowers are borne on the same branches. It has a typical life span of around 150-300 years, and reproduces very late (40-50 years old). Fruiting normally occurs every 5 to 8 years. Its seed production is characterised by irregular mast years (when a very heavy crop is produced), usually following hot summers of the previous year. The bitter edible nuts are sharply tri-angled and are borne singly or in pairs in soft-spined husks. The beech nuts are an important source of food for several animals and birds including squirrels, woodpigeons, woodpeckers and jays; they also play a major part in seed dispersal by hiding the seeds and failing to retrieve all of them¹.

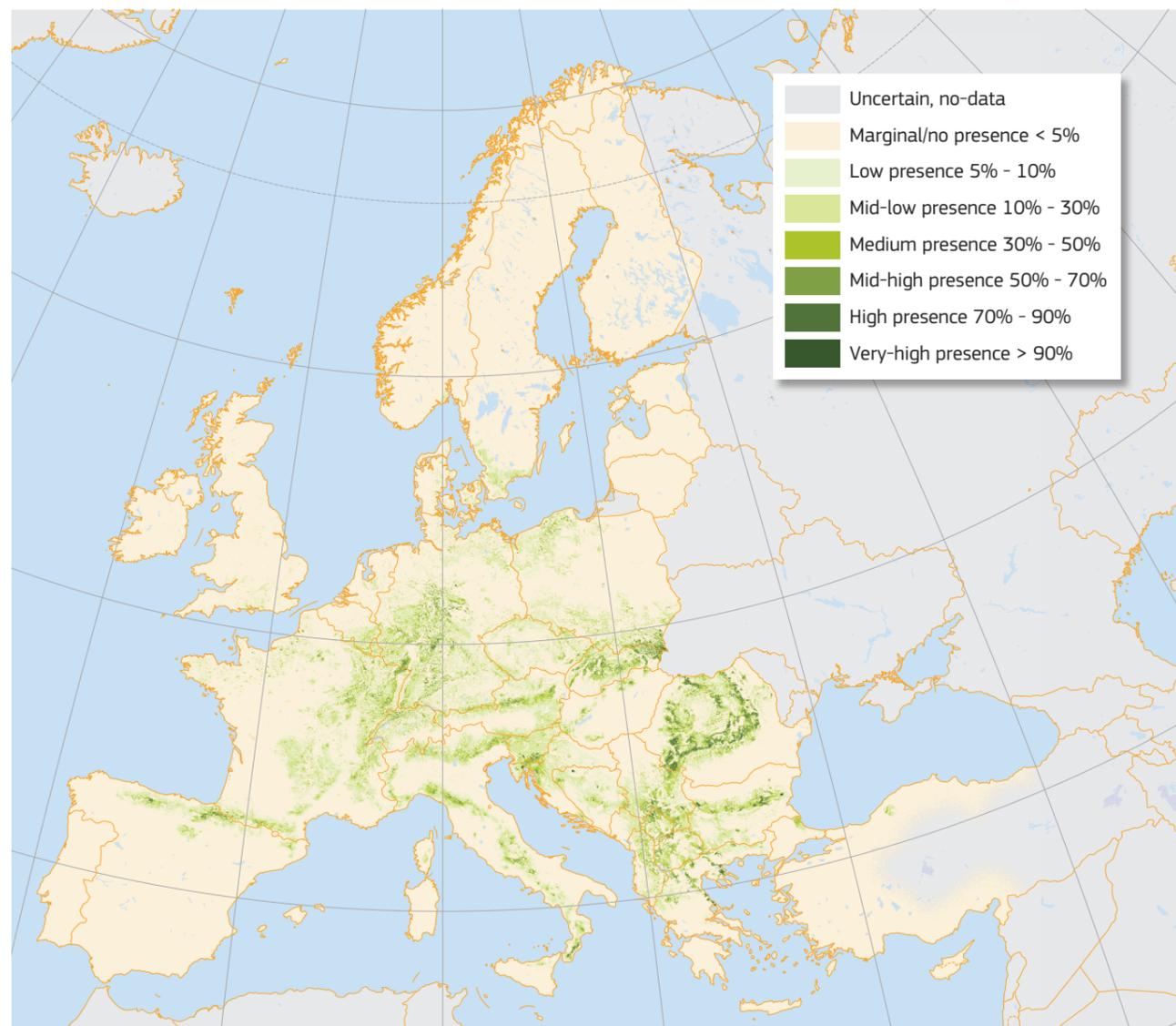
Distribution

Beech is widespread across Europe: it can be found from Sicily in the south to Bergen in southern Norway⁴⁻⁶. An analysis of pollen records indicate that the species has spread across Europe from small scattered populations left after the last glaciation, and is currently probably at its maximum post-glacial spread⁷. It needs a growing season of at least 140 days, and for this reason cannot survive too far north in Scandinavia⁷. Longitudinally its range is from the Cantabrian Mountains in the west to the Carpathians and Balkan Mountains in the east, although there are some areas in Europe where it is not found as a native tree, such as the Po valley and the Hungarian plain. As the climate becomes more continental in the eastern parts of Europe it is replaced by oriental beech (*Fagus*



Map 1: Plot distribution and simplified chorology map for *Fagus sylvatica*. Frequency of *Fagus sylvatica* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *F. sylvatica* is derived after Meusel and Jäger, and EUFORGEN^{27,28}.

orientalis). At the southern part of its range (Spain, Sicily) it is only normally present at altitudes of more than 1000m, and can even be found at elevations of up to 2000m^{1,8}. High summer temperatures, drought and moisture availability are limiting factors for the distribution of beech in Europe, but continentality is also associated with limiting its spread in north-western regions⁴. Climate change may have impacts on its future distribution, particularly at the extremes of its range where it is likely to become less competitive in the south and east (primarily because of drought), but could expand its range into Scandinavia and the Baltic⁹.



Map 2: High resolution distribution map estimating the relative probability of presence.



Large beech in a mountain pasture in Piani di Praglia (Genova, North Italy). (Copyright Ettore Balocchi, www.flickr.com: CC-BY)

Habitat and Ecology

Beech is a hardy species. It tolerates very shady situations (it is the most shade-tolerant broadleaved tree in its range¹⁰), so that natural regeneration is possible in silvicultural systems with continuous crown coverage as the seedlings are able to survive and grow below the canopy of established trees. The predominance of beech means a reduction of light level in the understorey vegetation level and in that case beech seeds survive better than those of other tree species. It is not particularly soil-sensitive¹¹ and grows on a wide variety of soils with a pH range from 3.5 to 8.5, although it cannot tolerate the most acidic conditions. Beech shows a moderate soil-acidifying ability¹². It prefers moderately fertile ground, calcified or lightly acidic and is also sensitive to late frosts¹³; therefore it is found more often on the side of a hill than at the bottom of a clayey basin. It grows well on soft soils in which the root system can easily penetrate and its optimal growth is in humid soils situated on calcareous or volcanic parent rocks. On the contrary, it does not thrive on sites that are regularly flooded or which have stagnant water, since it needs good drainage and will not tolerate waterlogged or compacted soils^{1,14}. Beech furthers soil conservation due to its production of a large quantity of litter (around 900 g/m² per year). The root system tends to be shallow, making it susceptible to drought when compared to coniferous stands¹⁵. However, there appears to be some genetic variability across different climatic zones, since trees in southern Europe are able to cope better with drought than those in the north¹.

Importance and Usage

Beech is an important European forestry tree. Fine grained and knot-free, the wood is hard and has a pale cream colour and good workability¹⁶. With around 250 known usages, it is one of the most diversely used tree species in Europe. Its wear-resistance, strength, and excellent bending capabilities make it ideal for boatbuilding, flooring, stairs, furniture, musical instruments (piano pinblocks), plywood, panels, veneering and cooking utensils such as bowls, platters and wooden spoons. It is also used for pulp and can be coppiced for fire wood and charcoal due to its relatively high energetic potential^{1,8,16}.

Threats and Diseases

The root system architecture of beech may vary depending on local soil conditions¹⁷. While generally showing a noticeable resistance to rockfall and wind-throw^{17,18}, under unfavourable local conditions a relatively shallow root system may make the tree vulnerable to wind-throw¹. The thin bark provides little protection from fire, and can also be damaged through stripping



Shiny dark green leaves with red galls caused by the fly *Mikiola fagi* (Diptera: Cecidomyiidae). (Copyright AnRo0002, commons.wikimedia.org: CCO)

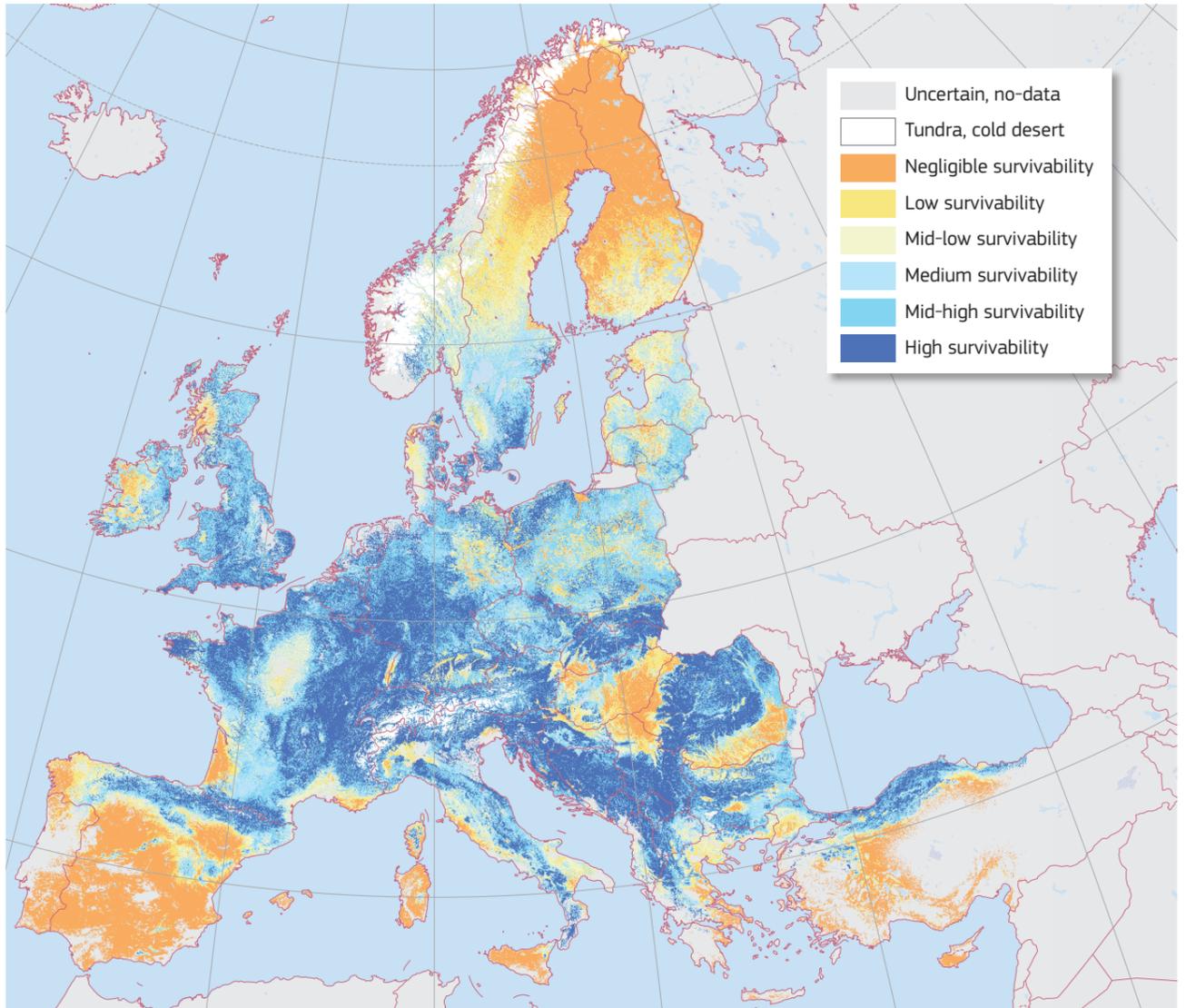
Fagus orientalis

Fagus orientalis, or oriental beech, is closely related to *Fagus sylvatica*. Some authorities consider them to be sub-species; others consider them to be two separate species¹. In appearance they are generally very similar. The leaves are slightly longer, darker and less glossy than those of European beech, and tend to have more vein-pairs (9-14 as opposed to 5-9)³. Oriental beech can be found in the Balkans, Anatolia, the Caucasus, northern Iran and Crimea¹⁸. Its range overlaps with that of the European beech and there is frequently hybridisation between the two¹⁸. Where both species are present, oriental beech tends to favour the valleys while European beech is found further up the slopes; this is because the European beech is more susceptible to late frosts¹².



Foliage and fruits of oriental beech (*Fagus orientalis*).
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and gnawing by squirrels and other mammals. The presence of deer is a limiting factor because they eat young stands. Spring frosts often damage young trees or flowers appearing at the same time as leaves. Young beech trees are susceptible to woolly aphid; mature trees can suffer internal rot by the fungus *Ganoderma applanatum*. Old trees (100-1200 years) may suffer 'red heart' which reduces stability and timber value⁸. Beech is among the susceptible hosts to *Phytophthora ramorum* and large regions across Europe have climatic suitability to this pest,



Map 3: High resolution map estimating the maximum habitat suitability.



Mature beech forest with autumn colour foliage in Delamere forest, Cheshire, UK.
(Forestry Commission, www.forestry.gov.uk: © Crown Copyright)

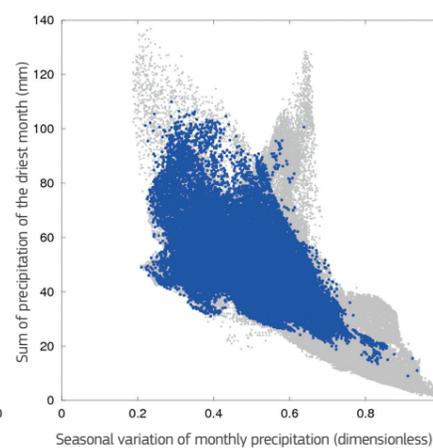
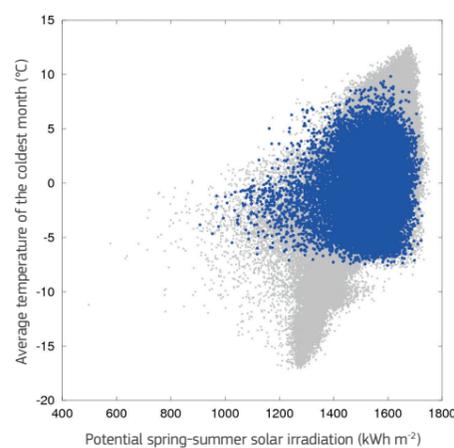
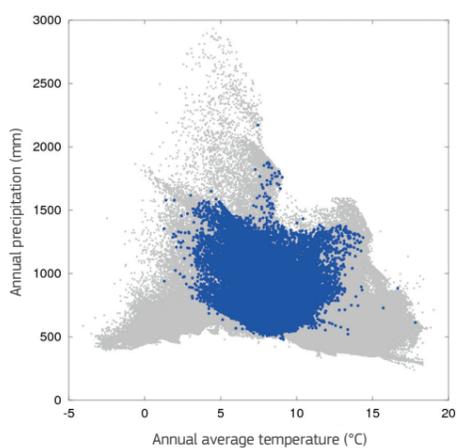
which may become a more serious problem in the future⁵. The large pine weevil (*Hylobius abietis*) is harmful for beech and markedly coexists with part of its natural niche¹⁹⁻²². Herbivory by short-snouted weevils (*Strophosoma melanogrammum* Forst. and *Otiorhynchus scaber*) is another threat to beech^{21, 22}.

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Field data in Europe (including absences) ● Observed presences in Europe ●

Autoecology diagrams based on harmonised field observations from forest plots.



This is an extended summary of the chapter. The full version of this chapter (revised and peer-reviewed) will be published online at <https://w3id.org/mtv/FISE-Comm/v01/e012b90>. The purpose of this summary is to provide an accessible dissemination of the related main topics.

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