

## Quercus suber in Europe: distribution, habitat, usage and threats

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*Quercus suber* L., known as cork oak, is an evergreen broadleaved tree native to the Mediterranean region. It is most noted for its thick bark which can be harvested every 9-12 years to be used for wine stoppers and a wide variety of other products. The bark is an adaptation to living in hot dry regions, as it can protect the tree and enable it to survive forest fires. Cork oak savannas are biologically very diverse landscapes with a high conservation and aesthetic value.

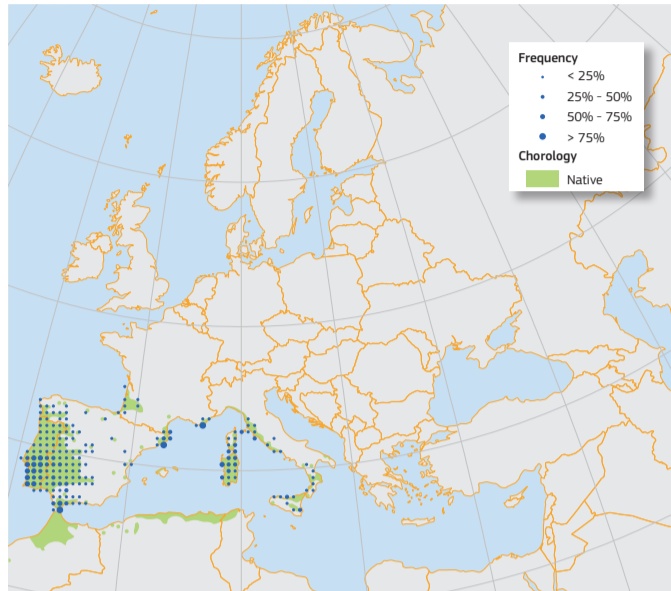
*Quercus suber* L. or cork oak is a medium-sized broadleaved tree. It is slow-growing and long-lived (about 200 years or more) and usually grows to 20m in height, but can reach 25m and a diameter of 1.5m in good conditions<sup>1,2</sup>. It has a tendency to form branches at low levels (cultivated trees are frequently pruned to prevent this and to maximise cork production<sup>2</sup>). Cork oak is a **monoecious** wind-pollinated species. The flowers appear from April onwards throughout the summer, and can give rise to both annual and biennial acorns. The number of acorns varies widely from year to year, with occasional very highly productive years followed by others with little or no production<sup>3</sup>. Acorns are 2-3cm in length in a fairly deep cup with elongated scales. The leaves are **sclerophyllous**, evergreen and oval in shape, 4-7cm in length, dark green above and pale greyish colour below. The bark is thick and fissured; if it is stripped to use the cork the underlying trunk is a rich red colour.

### Distribution

Worldwide, cork oak forests cover about 2.2 million hectares, almost all of which is in the Mediterranean countries of Algeria, France, Italy, Morocco, Portugal, Spain and Tunisia<sup>4</sup>. The most extensive forests are on the Atlantic coast of the Iberian Peninsula<sup>1</sup>. *Quercus suber* forests cover almost 1.5 million ha in Europe and 700000 ha in North Africa. Its distribution is fragmented, suggesting that it is mainly relictual<sup>5</sup>. The species has also been introduced to other countries outside the Mediterranean region in the twentieth century, either in order to produce cork or simply as an ornamental tree, and limited numbers can be found in Bulgaria, California, Chile, New Zealand, southern Australia and Turkey<sup>4</sup>.

### Habitat and Ecology

Cork oak is normally found in forests or open woodlands as the main tree species, or together with other Mediterranean trees such as maritime pine (*Pinus pinaster*) and other deciduous oak species<sup>5</sup>. Coverage is usually sparse - around 30-60 trees per hectare<sup>6</sup>. It frequently occurs in managed open woodland systems known variously as **dehesas** in Spain and **montados**



in Portugal, in which scattered mature trees coexist with an understorey composed of grassland for livestock, cereal crops and shrubland<sup>3</sup>. It needs an average temperature of around 15°C to thrive and cannot tolerate very low temperatures (below -10°C), which limits its northern and altitudinal range (most cork oak forests are found below 800m in elevation<sup>3</sup>). Apart from this it can survive in a variety of conditions and soil types, although it prefers sandy and lightly structured soils. It has a number of adaptations for growing in a warm and dry climate: it has an extensive and deep root system allowing it to cope well with drought, and it can also close the **stomata** on its leaves to restrict water loss<sup>3</sup>. However, it can also grow in areas of high rainfall (for example in some north-west areas of Portugal which have an average annual rainfall of 2400mm)<sup>1</sup>. In Mediterranean

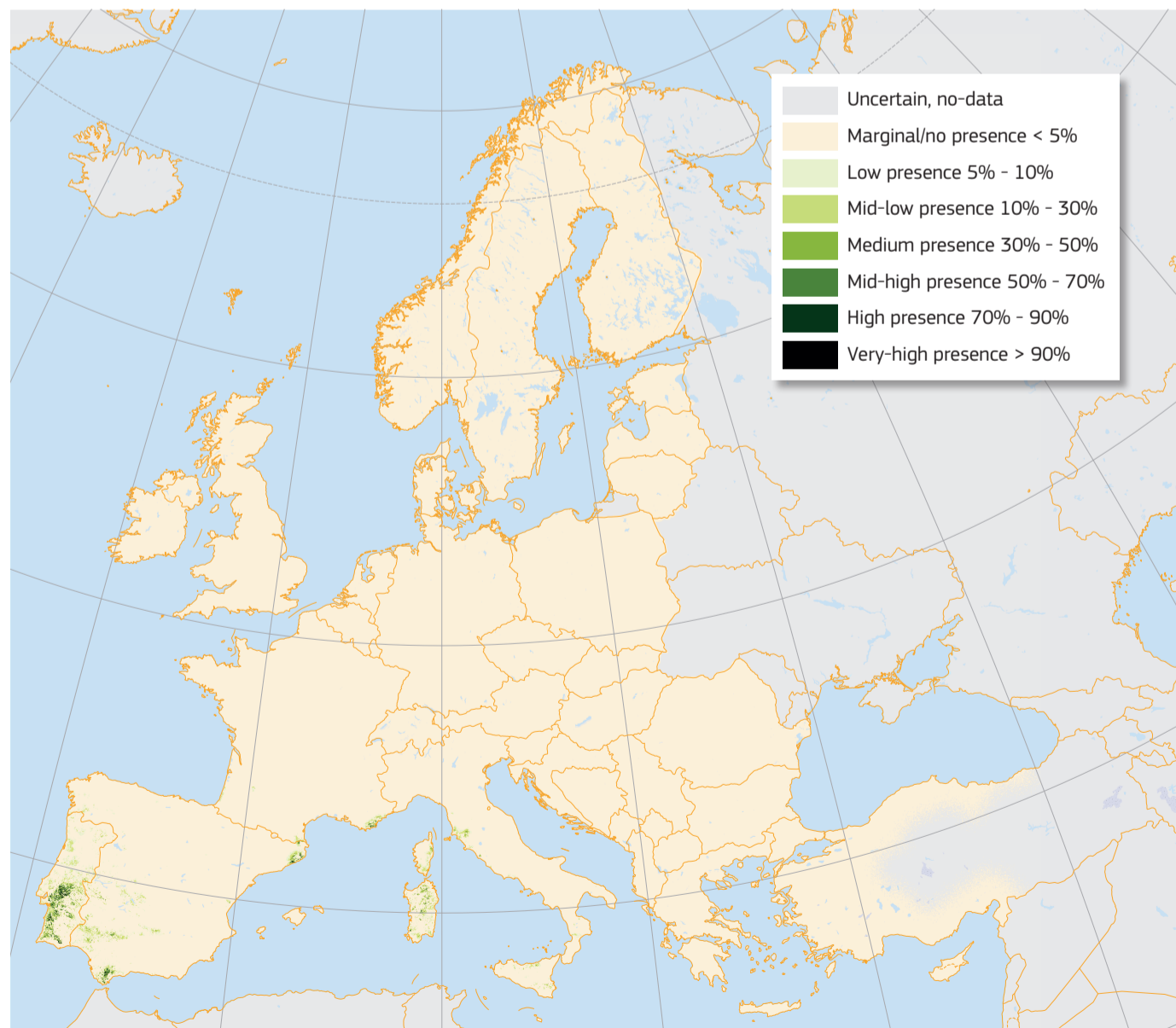


Maturing acorns covered up to ½ of the length by cups with elongated scales. (Copyright Xemenendura, commons.wikimedia.org. CC-BY)

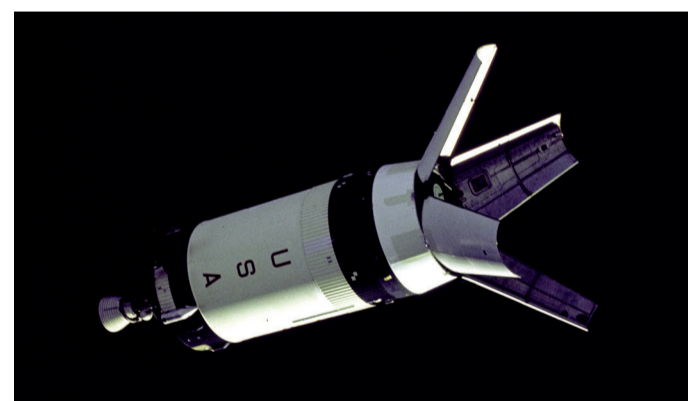
regions, fire is an ever-present hazard. Cork oak is well adapted to cope with fire, as its thick bark protects the tree enabling it to re-sprout from the stem after fire damage - the only European tree species with this capability<sup>7</sup>.

### Importance and Usage

This species is best known for its thick corky bark, which can be harvested in late spring or early summer every 9-12 years without killing the tree. Cork is a remarkable material. light, waterproof, rot-proof, flexible, chemically stable and a natural fire-retardant. It has been used by Man for at least 2000 years<sup>8</sup> and is the sixth-most important non-wood forest product globally<sup>4</sup>. It has many uses, including flooring, insulation and industrial products, although nearly 80% of the total value of the cork crop is for wine stoppers. Cork based agglomerates are an ideal core material for components of lightweight structures, and have even been used in aerospace applications<sup>9</sup>. Cork also has a place in scientific history: the seventeenth-century scientist Robert Hooke first described and coined the term "cell" after looking at cork cells through a microscope<sup>10</sup>. The open structure of cork oak forest landscapes are biologically very diverse and have high conservation value<sup>6</sup>, providing a broad range of goods and services apart from the cork harvest; these include woodfuel, pasture, herbs, mushrooms, beekeeping and leisure activities<sup>4</sup>. Many cork oak savannas are protected ecosystems in Europe<sup>11</sup>.



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



The exterior of Apollo's Spacecraft Lunar Module Adapter was covered by a thin layer of cork painted white to minimize thermal stresses during launch and ascent. (Copyright NASA, commons.wikimedia.org. PD)



Detail of the thick cork bark as extracted from the oak. (Copyright Sallyofmayflower, commons.wikimedia.org. CC-BY)



Debarking operations for cork production in a plantation near Jimena de la Frontera (Andalucía, Spain).  
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Dehesa with oaks managed for cork production in Navalcán (Toledo, Central Spain).  
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Grazing bulls in a dehesa with cork oaks near Casas Alcobaza (Extremadura, West Spain).  
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## Threats and Diseases

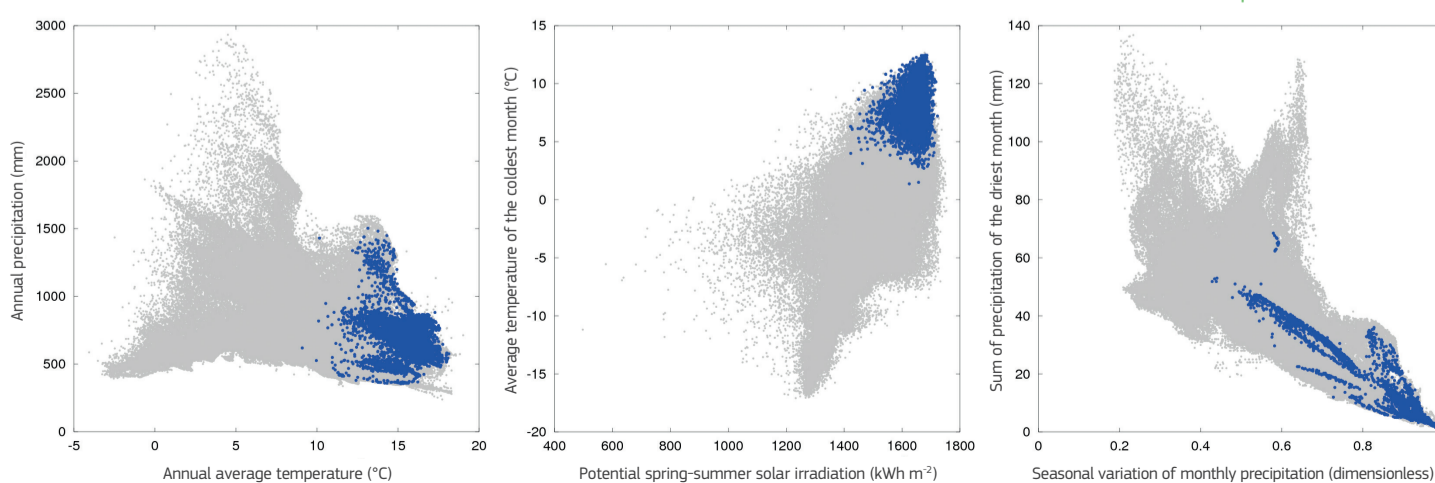
In the past, cork oak was not particularly seriously affected by pests or diseases, apart from occasional attacks by defoliator insects. However in recent decades there has been a rise in its vulnerability across the Mediterranean and there is now concern about its decline<sup>12</sup>. A 4-year European Commission-funded research programme "CREOAK" was set up in 2002 to address these concerns and to try to understand the scientific and management obstacles impeding the restoration and management of cork oak woodlands<sup>5</sup>. Its main threats come from changing use of the land and decline in management or abandonment of traditional practices in Europe, with the rising use of plastic stoppers for wine contributing to this decline. Wildfires and droughts contribute to conversion of cork forests to shrubland<sup>13</sup>. Once this has happened, it is difficult for new seedlings to re-establish the forest cover as the acorns are eaten by a variety of animals<sup>4, 6</sup>. Cork oak is vulnerable to root pathogens of the genus *Phytophthora* (*P. cinnamomi*, *P. ramorum*) and to *Lymantria dispar*<sup>15</sup>. *P. cinnamomi* is a biotic factor associated with cork oak decline<sup>16, 17</sup>. Furthermore, it is moderately susceptible to *Cryphonectria parasitica*<sup>15</sup>.

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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/e01ff11>. The purpose of this summary is to provide an accessible dissemination of the related main topics.

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Houston Durrant, T., de Rigo, D., Caudullo, G., 2016. *Quercus suber* in Europe: distribution, habitat, usage and threats. In: San-Miguel-Ayanz, J., de Rigo, D., Caudullo, G., Houston Durrant, T., Mauri, A. (Eds.), *European Atlas of Forest Tree Species*. Publ. Off. EU, Luxembourg, pp. e01ff11+

