

Pinus halepensis and Pinus brutia in Europe: distribution, habitat, usage and threats

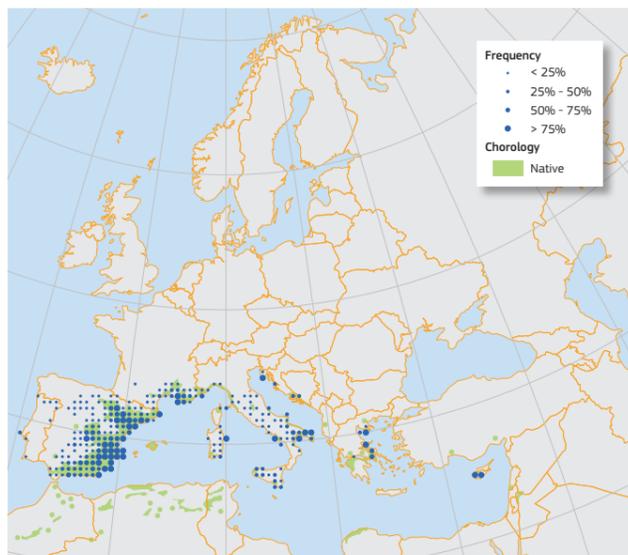
A. Mauri, M. Di Leo, D. de Rigo, G. Caudullo

Pinus halepensis Miller (Aleppo pine) and *Pinus brutia* Ten. (Turkish or Calabrian pine) are drought tolerant and fast growing coniferous species native of the Mediterranean region. *P. halepensis* widely covers the Mediterranean coasts concentrating in the western side of the basin, while *P. brutia* is located mainly on the eastern coasts. They are commonly found in coastal zones, and because of their drought tolerance, are well adapted to dry summer conditions. They are among the species most affected by wildfires in Europe, although they are fire resilient trees due to the high production of serotinous cones that favour a quick post-fire regeneration. These species have been widely planted between the thirties and seventies in Mediterranean areas for soil protection and wind breaks near the coasts.

Aleppo pine (*Pinus halepensis* Miller) and Turkish pine (*Pinus brutia* Ten.) are two systematically close tree species, which can naturally hybridize where they co-occur. Although some authors consider them as subspecies, in this chapter they are described as two separate pines¹. *P. halepensis* and *P. brutia* reach heights up to 20 and 35 m respectively^{1,2}. The diameter of the trunk ranges from 80 to 100 cm in *P. halepensis*, reaching up to 150 cm in *P. brutia*. In both species, the bark is greyish, initially smooth, turning to reddish-brown and finely fissured with ageing¹. Needles are light green in *P. halepensis* arranged in groups of two (occasionally three), between 6 and 12 cm long and less than 1 mm wide. In *P. brutia* the needles are instead dark green and between 10 and 18 cm long. In both species, stomata cover the whole surface of the leaves². Both have several branches forming a broadly conical to dome-shaped crown, flattening and opening up with age³. Both are **obligate** seeders characterised by a high production of conical cones (pedunculate in *P. halepensis* and **sessile** in *P. brutia*), moderately to highly **serotinous**, which remain closed on the tree for one or more years after seed maturation to open quickly as a result of fire related high temperatures^{4,5}. Their colour is grey to reddish-brown and between 5 and 12 cm in length⁵. *P. halepensis* is characterised by a deep root system with a woody tap root and vigorous laterals⁴. The name of *P. halepensis* is derived from the city of Aleppo (Haleb) on the coast of Syria², while the name *P. brutia* is thought to derive from an ancient Roman district (Brutium). *P. brutia* is also called Calabrian pine after its first botanical description in Calabria (South Italy)¹.

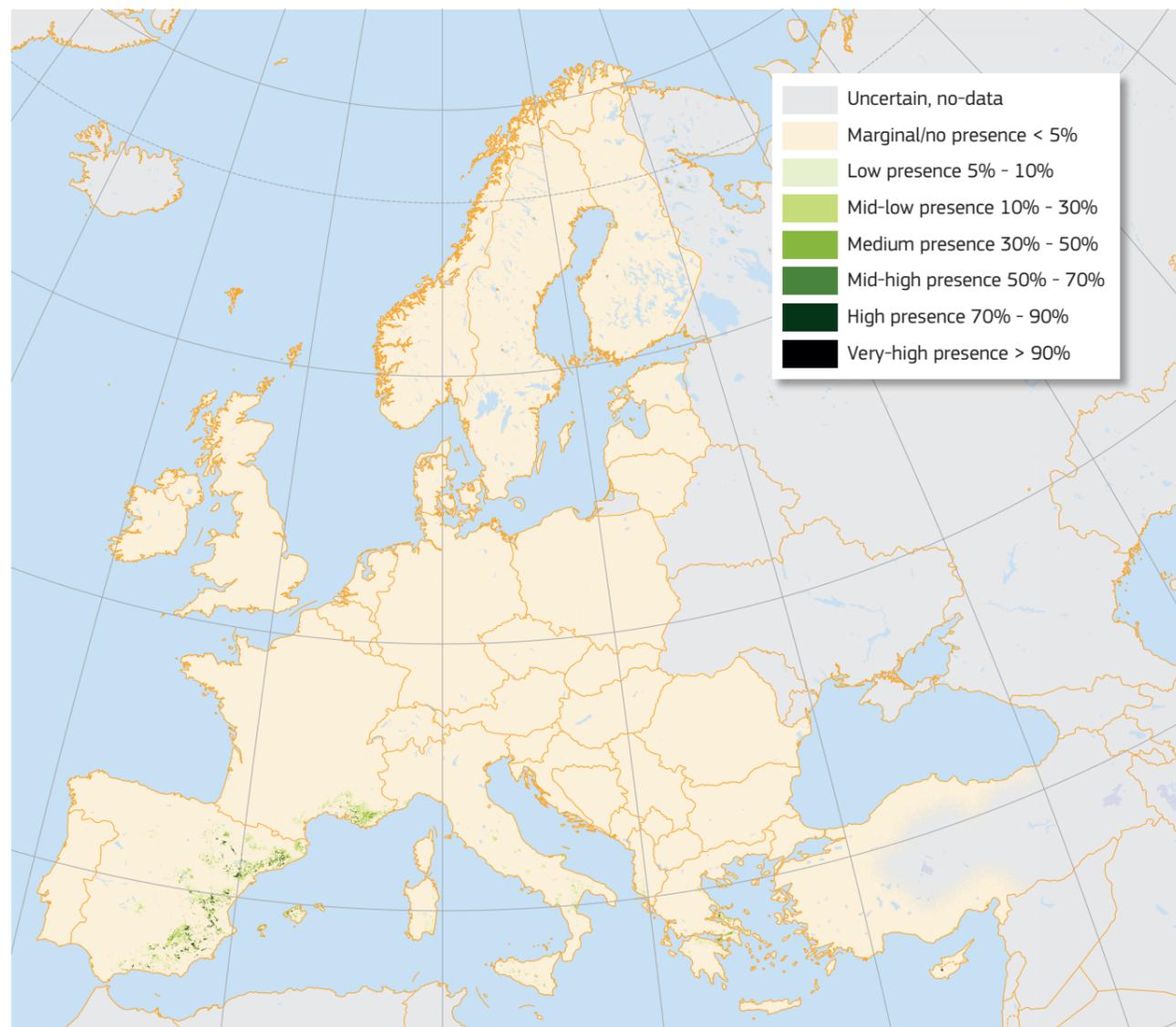
Distribution

The range of *P. halepensis* and *P. pinaster* is in the Mediterranean, Anatolian and Macaronesian regions⁶⁻⁸. *P. halepensis* is the most widely distributed and abundant among the Mediterranean pines, covering nearly 6.8 million ha of this region¹, extending from the Western Mediterranean (Spain, Morocco), where it is most abundant, to Lebanon through Southern



Map 1-A: Plot distribution and simplified chorology map for *Pinus halepensis*. Frequency of *Pinus halepensis* within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *P. halepensis* is derived after Critchfield and Little, and EUFORGEN^{24,25}.

France, Italy, Greece and Turkey in South Europe and Algeria, Tunisia, Libya in North Africa. *P. brutia* is instead mainly located in Turkey, Crete, Cyprus, Syria and Lebanon with a few remains in Iraq and Iran^{2,9}. Bioclimatic envelope models predict that the suitable climatic area of *P. halepensis* is in expansion¹⁰⁻¹². It can already be observed that in the mountainous regions close to the coast *P. halepensis* is shifting upwards, replacing species from lower elevations such as Scots pine (*Pinus sylvestris*) in Southern France¹³. A decrease in summer rainfall will also probably favour *P. halepensis* at the expense of evergreen oaks¹⁴.



Map 2: High resolution distribution map estimating the relative probability of presence for *Pinus halepensis*.



Serotinous cone of *Pinus halepensis* that opens quickly when exposed to fire. (Copyright Tomás Royo, www.flickr.com. CC-BY)

Habitat and Ecology

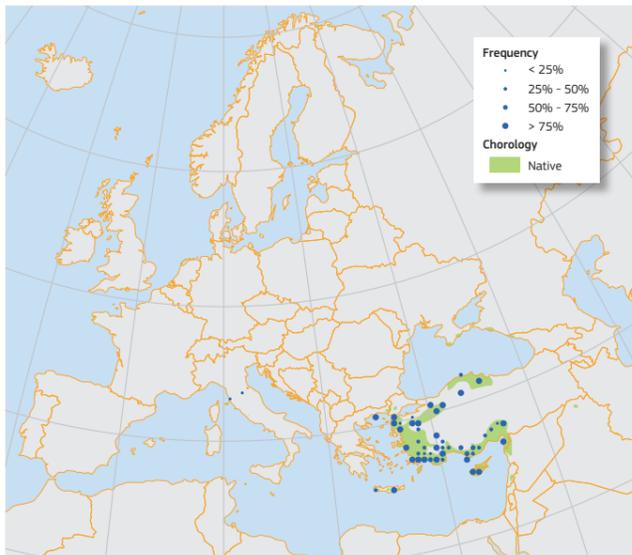
P. halepensis is mainly found at lower altitudes, occurring mostly in the thermo- and meso-Mediterranean zone, although it is also present at higher altitudes (more than 2000 m in Morocco)¹⁵. Its habitat ranges from the lower arid or semiarid to humid bioclimates favouring absolute minimum temperatures of between -2 and 10°C and precipitation between 350 and 700 mm on marly limestones and marls^{9,16}. It is a very drought resistant, **thermophilous** species that grows very well in the hotter parts of the Mediterranean where forest fires are frequent⁵. *P. halepensis* can successfully colonise limiting dry conditions areas creating highly resilient forest stands³, but more often it is found scattered in **garrigue** or **maquis** vegetation colonising abandoned lands and burnt areas. In the absence of fire for long periods it can be replaced by holm oak (*Quercus ilex*) and cork oak (*Quercus suber*) as an intermediate step in the successional series to broadleaved trees¹⁶. In the past, unplanned exploitation and intensive harvesting have considerably disturbed the original forest structure of Aleppo pine promoting monospecific stands where pine growth is maximized by decreasing interspecific competition with other trees^{16,17}. However, under-management can also be a problem, resulting in dense *P. halepensis* forests with almost null productivity rates and high fire vulnerability¹⁶. *P. brutia* is a stricter species in terms of water requirements and it is not frequent in arid or semiarid climates¹⁶. *P. brutia* is often found together with cypress (*Cupressus sempervirens*) and Greek juniper (*Juniperus excelsa*) to form mixed open-forests or with kermes oak (*Quercus coccifera*) and Palestine oak (*Quercus calliprinos*), mastic (*Pistacia lentiscus*) and other drought tolerant trees and shrub to form open-woodland¹.

Importance and Usage

P. halepensis is not used in commercial forestry due to its size, shape and poor wood quality². However, being the main source of wood in many Mediterranean countries it is used for various purposes including firewood as well as raw material for the pulp and paper industry. In the past it was also used for mine props, railway sleepers and telephone poles¹. By being well adapted to drought, poor soil and recurrent fires, Aleppo pine



Male flowers of *Pinus halepensis*. (Copyright Victor M. Vicente Selvas, commons.wikimedia.org. PD)

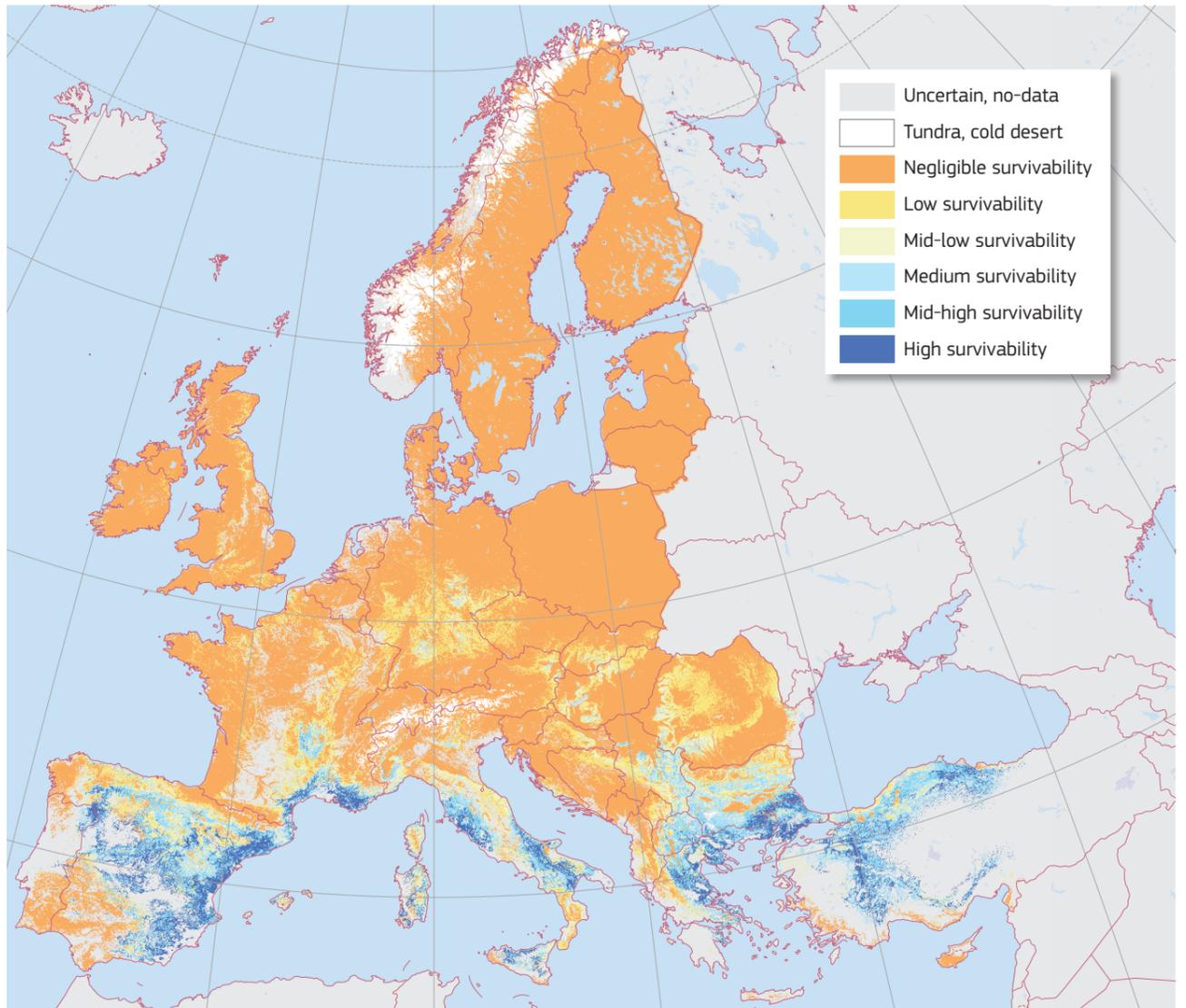


Map 1-B: Plot distribution and simplified chorology map for *Pinus brutia*.
Caption: Frequency of *Pinus brutia* within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *P. brutia* is derived after Critchfield and Little, and EUFORGEN^{24, 26}.

has been used in several afforestation programmes, especially between the thirties and seventies, aiming at soil protection and wind breaks near the coast^{9, 18}. It is often used for improving water infiltration on hilly slopes² and to prevent soil erosion on dry slopes¹, although other studies suggest that plantations of Aleppo pine do not improve soil conditions¹⁷. Seeds are also used for making pastry in several areas, mainly in North Africa¹⁶. The resin extracted from the plant is still presently used in Greece for wine production³. In Greece and Turkey the honeydew released by the sap-sucking insect *Marchalina hellenica* is still used to produce honey^{19, 20}. There is some use for pallets and chipping for particleboards as well as for boat making at a local scale. The wood is frequently planted in rain-fed suburban parks and road lines³. *P. brutia* wood has been used in the pulp industry, carpentry and to produce railway sleepers and telephone posts among others¹. It has also been widely planted in the Eastern Mediterranean and around the Black Sea, due to its ability to grow in Mediterranean climates¹. Since ancient Greek times the resin of both *P. halepensis* and *P. brutia* has been used to seal amphorae containing wine, and later on to flavour the Greek traditional white wines called "Retsina"²¹.



Needles of *Pinus brutia* are usually longer than those of *Pinus halepensis*.
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Map 3: High resolution map estimating the maximum habitat suitability for *Pinus halepensis*.

Threats and Diseases

The most widespread pests of *P. halepensis* include *Thumetopoea pityocampa*, *Orthomicus erosus*, *Monochamus galloprovincialis*, *Matsucoccus josephi*, *Leucaspis pini*, *Leucaspis pusilla*, *Cenopalpus wainsteini* and *Hylurgus destruens*. The bacteria *Pissodes castaneus* might also be the cause of the knot disease of *P. halepensis*. A threat recently identified in France is the canker *Crumenulopsis sororia*⁹. In the Mediterranean



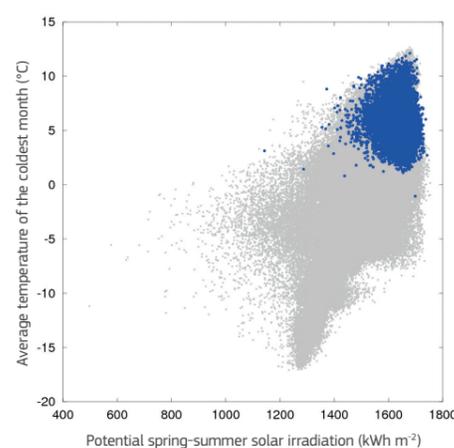
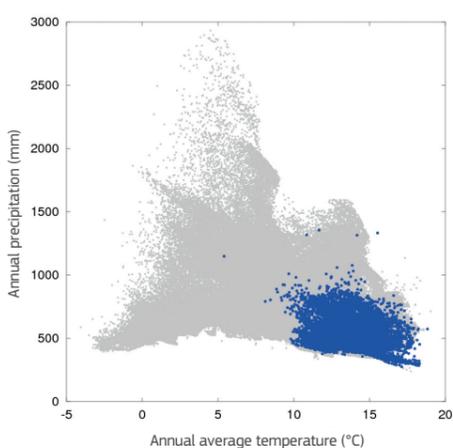
Pinus brutia woodland in Argaka, Cyprus.
(Copyright S. Rae, www.flickr.com. CC-BY)

region Aleppo pine is characterised by large-scale dieback that starts from the desiccation of the lower branches and extends to the whole tree². Similarly to many pines, the Aleppo pine is vulnerable to the pitch canker (*Gibberella circinata*, syn. *Fusarium circinatum*), with an outbreak in Italy and with a virulence which might expand due to climate change^{22, 23}.

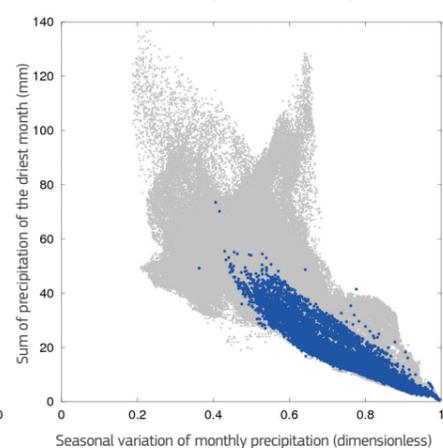
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Field data in Europe (including absences) ● Observed presences in Europe ●



Autecology diagrams based on harmonised field observations from forest plots for Pinus halepensis.



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/e0166b8>. The purpose of this summary is to provide an accessible dissemination of the related main topics. This QR code points to the full online version, where the most updated content may be freely accessed. Please, cite as:
Mauri, A., Di Leo, M., de Rigo, D., Caudullo, G., 2016. *Pinus halepensis and Pinus brutia 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. e0166b8+

