

Pinus pinaster in Europe: distribution, habitat, usage and threats

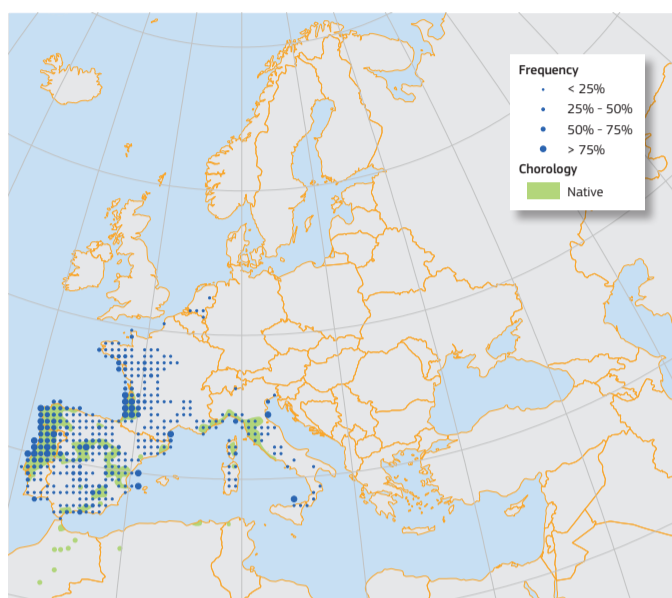
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The maritime pine (*Pinus pinaster* Ait.) is a widespread medium-size tree native to the western Mediterranean basin. Its genetic variations, associated with a natural and artificial wide range of geographical locations, result in several subspecies that show a versatile adaptation to ecological factors. This pine dwells well in temperate-warm locations, from coasts to high mountains. It does not tolerate shade and shows preference for siliceous and sandy soils. Due to its undemanding behaviour, salt spray tolerance and fast growth, it has been used for soils protection, reforestation of degraded areas and dunes stabilisation, as shelterbelts and also in intensive plantations. Its wood is appreciated for producing construction wood, poles and furniture. The maritime pine has been also traditionally utilized for the extraction of resin obtaining turpentine and rosin. In the southern hemisphere, where maritime pine has been introduced for environmental and economical purposes, it has been considered as a highly invasive species.

The maritime pine (*Pinus pinaster* Ait.) is a medium-sized pine 20-30m tall, exceptionally reaching 40m. The bark is bright reddish-brown, thick, deeply fissured¹. The crown is regular, ovoid or conic in young pines and irregular and open in adult pines, with branches densely clothed at the ends. Needles, occurring mostly in pairs but occasionally in groups of 3², are 10-25 cm long, with shiny green and well-marked lines of stomata on both faces. They endure 2 to 3 years. Light brown cones, often collected as ornaments, are persistent and grouped in clusters. They are slightly asymmetrical, with ovoid-conic shape and around 15 cm long (in a range of 8-22 cm). Their ripening occurs two years after pollination and they open the same summer or up to 10 years later. In those locations with high intensity and frequency of fires, usually serotinous cones are present³. The scale presents broad ridge and up-curved prickle⁴. Seeds are shiny black-brown above and matt grey below with a wing which is easily removed⁵. Its root system consists in a deep taproot with well-developed secondary roots.

Distribution

Maritime pine is a thermophilous widespread conifer original from the western Mediterranean Basin. It occurs in the Iberian Peninsula, South France, West Italy, western Mediterranean isles, North Morocco, Algeria and Tunisia. It has increased its presence, due to artificial plantations and its naturalisation, such as in the coast of southwestern France, Greece and Adriatic countries, but also in north Europe, such as United Kingdom and Belgium⁶⁻⁹. As with other European pines, encroachment of former agricultural fields and plantation programmes, motivated by soil protection and reforestation of degraded areas, has resulted in its expansion during the 19th and 20th centuries¹⁰. Moreover, intensive plantations were also established in the southern



Map 1: Plot distribution and simplified chorology map. Frequency of *Pinus pinaster* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *P. pinaster* is derived after Critchfield and Little⁸.

hemisphere with both economic and environmental objectives, in southwestern Australia, New Zealand, South America, United States and South Africa, where it has been considered an aggressive coloniser^{9, 11, 12}.

Habitat and Ecology

Maritime pine is a light demanding and fast-growing species that occupies a broad range of elevations, climates and soils, presenting remarkable genetic variation as a result^{13, 14}. There



Yellow male flowers arranged in ovoid clusters at the top of the shoots. (Copyright MarioM, commons.wikimedia.org; PD)

is debate about the number of subspecies, with some authors recognising as many as five different subspecies corresponding to several geographical locations, while others consider up to 18 subspecies that could be grouped in 3 main groups: Atlantic, Circum-Mediterranean and Maghrebian¹⁵⁻¹⁷. Maritime pine is ecologically versatile, showing a wide range of expressive traits regarding growth characteristics, frost resistance and adaptation to summer drought and limestone substrates. Naturally, it grows in warm temperate regions with an oceanic influence on climate, mainly in humid and sub-humid areas, where annual rainfall is greater than 600mm. In spite of that, it is possible for trees to survive in areas with only 400mm annual precipitation, providing there is sufficient atmospheric moisture. Maritime pine cannot tolerate shade and exhibits preference for siliceous soils with a coarse texture, especially sandy soils, dunes and other poor substrates. However, some subspecies can be found also inhabiting calcareous soils⁹.

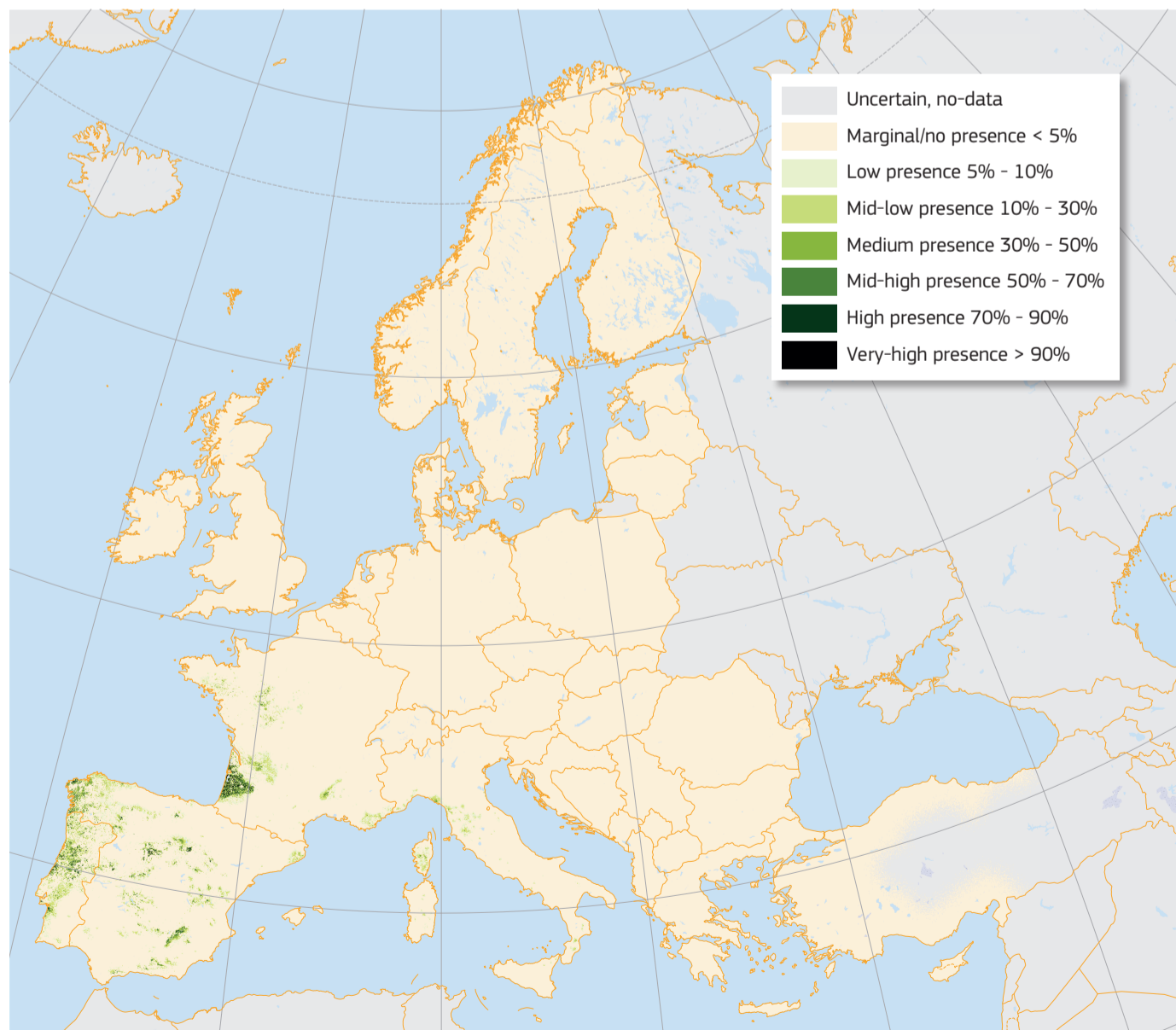
It inhabits from sea level in coastal lowlands to moderate elevations in the Iberian Peninsula (1600m) and inland Corsica, up to around 2000m in Morocco^{15, 18}. Easily found establishing pure and open stands or mixed with other species, such as Aleppo pine (*Pinus halepensis*) and stone pine (*Pinus pinea*) on sandy coasts or sometimes in higher rocky hills. In Morocco it is a constituent of mixed coniferous forests with black pine (*Pinus nigra*), Moroccan fir (*Abies pinsapo* var. *marocana*), Atlas cedar (*Cedrus atlantica*) and European yew (*Taxus baccata*)⁶.

Importance and Usage

The maritime pine has been widely used for dunes stabilisation¹⁸, to enable the agricultural use of large areas along the western coast of the Iberian Peninsula, and as shelterbelts protecting agricultural crops against salt spray⁹. In southwestern France it has also been used for sanitation plantations and economic development in the Landes¹⁸, the largest continuous plantation forest in Europe where Maritime pine is the main species¹⁹. Further, due to its fast growth characteristics and tolerance to poor soils, other uses include soil conservation, and protection of slopes against erosion, as well as shade tree in picnic areas, camp sites and recreational parks. The wood is the major product that is obtained from maritime pine, which



Reddish-brown plates of the bark divided by deep fissures. (Copyright Jean-Pol Grandmont, commons.wikimedia.org; CC-BY)



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



Asymmetrical cones of the maritime pine: they can grow up to 15 cm long maturing in two years.
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has a broad range of final products such as construction wood, furniture, poles and posts¹⁴. Resin is the most important of the non-wood products and is used, directly or indirectly after distillation, to make turpentine and rosin, both used in a wide range of products: oils, varnishes, adhesives, waxes, soaps and medicines¹⁸. Its bark is also distilled to produce tar, or chipped and composted to produce a low-weight substrate for nursery containers^{14, 18}. Finally, its stands are also an ideal ecosystem for the development of edible fungi, such as mushrooms of genus *Boletus* (porcini) and *Lactarius* (milk-caps)⁹.



Majestic maritime pine in Landes Forest (Aquitaine, France).
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Maritime pine forest on limestone soils in the Trevenque Mountain of Sierra Nevada (Granada, Spain).
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Threats and Diseases

This pine is a **pyrophyte** species, so that the fire is often vital to maintain the Maritime pine status in its ecosystems, but it is also a major hazard in plantations and its most significant threat in the Mediterranean Basin^{20, 21}. The closed canopy and high tree stocking that characterise silvicultural practices for maximizing biomass production, generate accumulations of fuel with the potential for extreme fire behaviour²², besides that abundant understorey in pure stands is a key factor in determining stand flammability. Regarding biotic threats, serious injuries are attributed to the exotic pine wood nematode (*Bursaphelenchus xylophilus*), which is responsible for the pine wilt disease. This nematode is considered one of the most serious biological invasions and damaging diseases that has affected conifer forests worldwide²³. Further, other damage that can weaken the trees, causing the loss of plant growth and reducing wood quality in the plantations, with important economic impact, is caused by numerous pests. Cones and seeds are affected by the pine cone weevil (*Pissodes validirostris*) and worm (*Dioryctria mendacella*). Buds, shoots and twigs are fed by the pine shoot moth (*Rhyacionia buoliana*). The main needle pests are the leaf-feeding larvae of the pine processionary moth (*Thaumetopoea pityocampa*) and the pine sawfly (*Neodiprion sertifer*), while the maritime pine bast scale (*Matsucoccus feytaudi*) is a needle sap sucking pest. Finally the fungi *Lophodermium* spp. and *Cyclaneusma niveum* cause the needle cast. Bark can be infested by beetles of family Scolytidae, such as *Ips sexdentatus*, *Tomicus* spp. *Orthotomicus erosus*, *Pityogenes bidentatus* and *Hylaster* spp. Roots are attacked by the root rot fungi *Armillaria* and *Heterobasidion*^{9, 14}. The large pine weevil (*Hyllobius abietis*) is among the most serious pests affecting young coniferous forests in Europe^{24, 25}, and the maritime fir partly coexists with the natural

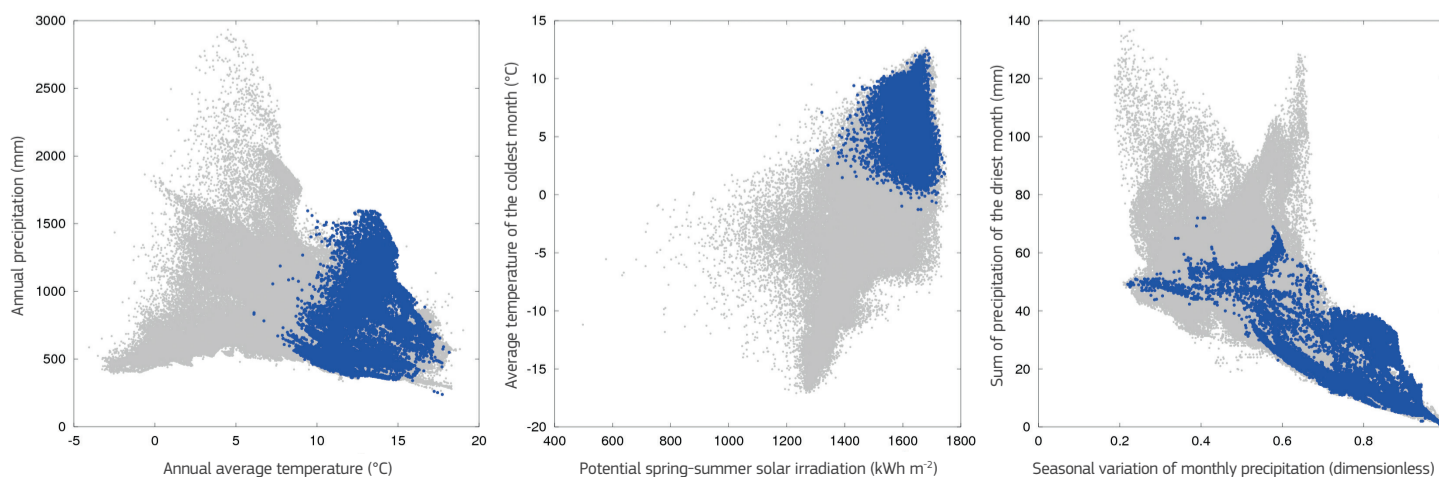
niche of this weevil²⁴. Outside Europe the maritime pine has been rated as one of the five most invasive pines²⁶, particularly in South Africa, with impacts on species richness, accelerating soil erosion and altering the water levels^{11, 18, 27, 28}.

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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/e012d59>. The purpose of this summary is to provide an accessible dissemination of the related main topics.

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