Populus alba

Populus alba in Europe: distribution, habitat, usage and threats

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The white poplar (*Populus alba* L.) is a medium-sized tree commonly occurring in coastal and riparian forests of central and southern Europe. Its wide range covers from the Mediterranean region to Central Asia. It is a fast-growing pioneer tree, which thrives in borders and sunny habitats in sandy alluvial soils and dunes. Its reproduction is primarily by root suckers arising from lateral roots from which it forms dense and large colonies. It is used as an ornamental tree appreciated for its attractive double-coloured foliage, as a windbreak and for dune stabilisation thanks to its tolerance of salt winds. The white poplar is free from threatening diseases, while it is considered an aggressive invasive species in North America, New Zealand and South Africa. This poplar covers an important ecological role as a component of floodplain mixed forests, which are ecosystems with very high biodiversity and that are strongly threatened by human activities.

The white poplar (*Populus alba* L.) is a medium-sized tree, reaching at maturity 30 m in height and 1 m in diameter, rarely up to 40 m[1], and living to 300-400 years[2, 3]. The trunk is never straight, usually leaning to one side[4, 5]. The crown is normally broad and rounded with large branches inserted irregularly, often bifurcated[2]. Above or in young trees the bark is creamy white pitted with small black diamonds; it is black and coarsely cracked at the base of older trees[4]. The leaves are alternate, morphologically variable, with 3-5 lobes coarsely toothed, 6-12 cm long and longer than they are wide[1-3, 6]. The colour is shiny dark-green on the upper side and white with dense hair on the lower side[2, 5]. Like other poplars, it is a **dioecious** species[1]. Flowers are out before the leaves in early spring[4]. The male catkins are grey with red stamens, 5-8 cm long; the female catkins are greyish-green, 10-15 cm long, forming fluffy seeds in early summer[2, 4].

Distribution

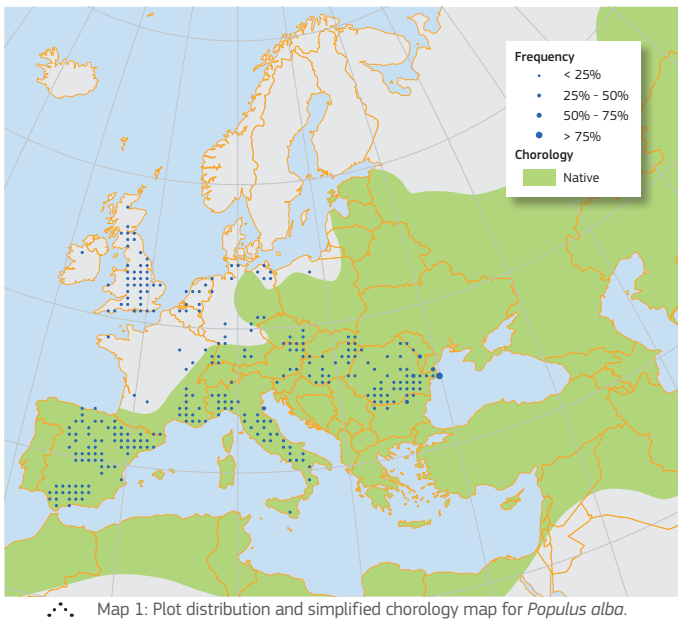
This tree is native in riparian steppe and coastal forest communities of central and southern Europe. It occurs over a wide range, from North Africa to Poland and from the Iberian Peninsula to western Siberia and Central Asia[2, 6-9]. It was introduced in the United States in the 18th century as a shade and ornamental tree and more recently in all other continents, becoming naturalised in many areas and invasive in some countries[10-14].

Habitat and Ecology

The white poplar occurs spontaneously along river valleys in warm temperate and Mediterranean zones where soil-water is available[15, 16]. It is a fast-growing and light demanding tree, colonising woodland edges and open sunny habitats, including meadows, wetlands and riparian zones. It grows in most sites, tolerating from waterlogged to drought habitats and from acid to strong alkaline soils, but developing in shrub form in extreme conditions[17]. It performs with high growing rates on optimal sites, characterised by good water availability and well-textured soils that have neutral-alkaline pH and which are rich in nutrients[3, 15, 17, 18]. Reproduction is primarily by vegetative means, through root suckers. They arise from adventitious buds on the lateral root system, which can grow as far as 30-50 m from the plant. New plants may also establish through tree fragments, which can easily root in suitable environments. Suckers from a single tree can quickly develop a dense and large colony, shading out competitive vegetation[10, 11, 18]. Mature trees also produce abundant wind-dispersed seeds that may be carried long distances[11]. The white poplar hybridises naturally with Eurasian aspen (*Populus tremula*). The resulting hybrids are known as grey poplars (*Populus* x *canescens*), which is a morphologically intermediate species, but which exhibits more vigour than either parent[2, 4, 5]. This poplar is a common species of floodplain forests in early- to mid-**seral** vegetation communities[10]. In central and southern Europe it dominates and co-dominates in riparian woodland of the central-western Mediterranean zone with willows (*Salix alba, Salix fragilis*), black poplar (*Populus nigra*), and alder (*Alnus glutinosa*). In the wooded steppe zone it is dominant on sandy soils having originated from alluvial deposits and on sand dunes bordering riverine gallery forests[9]. It occurs also as a secondary species in **hygrophilous** floodplain forests of the temperate zone dominated by pedunculate oak (*Quercus robur*), ashes (*Fraxinus excelsior, Fraxinus angustifolia*), elms (*Ulmus* spp.) and alder (*Alnus glutinosa*), and in eastern Mediterranean riparian forests dominated by oriental plane (*Platanus orientalis*)[19, 20].

Importance and Usage

White poplar is not an important species commercially. It is widely used in interspecific breeding programmes to introduce valuable traits into poplars of more economic importance. As other fast growing Salicaceae, this poplar may have a multifunctional role for pollution mitigation, microclimate regulation and improved structural and biological diversity in open agricultural landscapes[21]. Its broad geographical distribution overlaps with many areas in Europe affected by high erosion rates, including moist slopes with high drainage-area within the European mountain systems[22]. In these critical areas, white poplar complements key forest ecosystem services such as soil stabilisation and watershed protection[23]. More generally, white poplar is used for erosion control along river banks and roadsides, windbreaks and land reclamation. **Silvoarable agroforestry** with this species[24] may be exploited in Mediterranean areas with high potential soil erosion, also considering the effectiveness of its cover-management on erosion rates[25, 26]. Thanks to its salt and sandy soil tolerance, it is also used near coasts in windbreaks against salty winds and for dune stabilisation[2, 15]. It is further exploited for **phytoremediation** with the hybrids *Populus alba* x *tremula* and *Populus tremula* x *alba* [27]. The wood is not of high quality, especially from natural stands, being woolly in texture, of low flammability, not durable, very light and soft, so it is suitable only for local and artisan use. However, specialised plantations are established for wood industries, where other poplars do not perform well, for example where the water table is inaccessible or the soil is poor or saline. In such cases, the wood can be used for biomass energy, as pulpwood for paper, for packaging (crates and boxes), pellets and partially as saw-logs. Plant density on pure plantations can be higher than other poplars and the rotation reaches 18-25 years[2, 6, 15]. It is widely planted as an ornamental tree in parks and gardens, for its attractive double-coloured foliage[2, 6]. Poplar leaves could be used as cattle feed and as bio-monitors for soil pollution[15, 28]. White poplar is among the group of plants with an important emission of **isoprene**, which is one of the **biogenic volatile organic compounds** affecting a complex chain of feedbacks between the terrestrial biosphere and climate, with relevant although not yet completely understood implications under the ongoing climate warming[29-31]. This poplar covers an important ecological role as a component of floodplain forests. These forest ecosystems host a very high diversity of plants and animals, providing corridors through the landscape, sites for water storage and groundwater recharge during floods, opportunities for timber extraction, and diffuse pollution control by recycling nutrients in farmland runoff[32, 33].



Map 1: Plot distribution and simplified chorology map for *Populus alba*. Frequency of *Populus alba* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *P. alba* is derived after Isebrands and Richardson[16].

Creamy white bark with small black diamonds. (Copyright Silvano Radivo, www.actaplantarum.org: AP)

Threats and Diseases

Like other poplars, it hosts a large number of insects, but only a few of those need to be controlled especially in plantations. Among the leaf defoliators, the main ones are the moth *Hyphantria cunea* and the large poplar-leaf beetle *Chrysomela populi*. Wood diseases can occasionally be caused by the goat moth *Cossus cossus* and the longhorn beetles of genus *Saperda*, even if their **xylophagous** caterpillars are found mainly in other poplar species. The soil

Free-standing trees develop a broad and rounded crown. (Copyright AnRo0002, commons.wikimedia.org: CC0)

Small branchlet with male catkins floating in the water.
(Copyright Rob Hille, commons.wikimedia.org: PD)

Lobed leaves are shiny dark-green on the upper side and white with dense hairs on the lower one.
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bacterium *Agrobacterium tumefaciens* can cause serious damage with canker infections. The main fungi affecting leaves and rusts causing premature defoliations are *Melampsora* spp., *Marssonina castagnei*, and *Venturia* spp. on young plantations[2, 15, 34]. The Asian longhorned beetle (*Anoplophora glabripennis*) may attack the white poplar which, however, shows a remarkable resistance and may thus potentially act as overwintering reservoir of the beetle[35, 36]. *Leucoma salicis* may infestate this tree, although outbreaks in central Europe may be mitigated by numerous natural enemies[36]. *Chrysomela tremulae*, a leaf-feeding beetle, can damage young plantations of the hybrid *P. tremula* x *alba* as well as of the white poplar[36]. This species forms with other **hygrophilous** broadleaves the floodplain mixed forests, one of the most threatened natural ecosystems in Europe, which has seen during the last centuries a 90% of the original area for settlement development, agricultural land use, flood defence, etc., remaining in fragments and often in critical conditions[32, 33]. For this reason several riparian habitats are now protected by European legislation[37, 38]. On the other hand, the white poplar can be an aggressive exotic tree species, so that in many countries like the United States and Canada, Australia, New Zealand and South Africa it is considered an invasive plant (noxious weed). In some cases a control programme has been activated using herbicides for limiting its invasiveness, especially in natural communities[2, 10-14].

Female catkins maturing after pollination.
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White poplars growing near a lagoon in the Doñana National Park (Andalusia, Spain).
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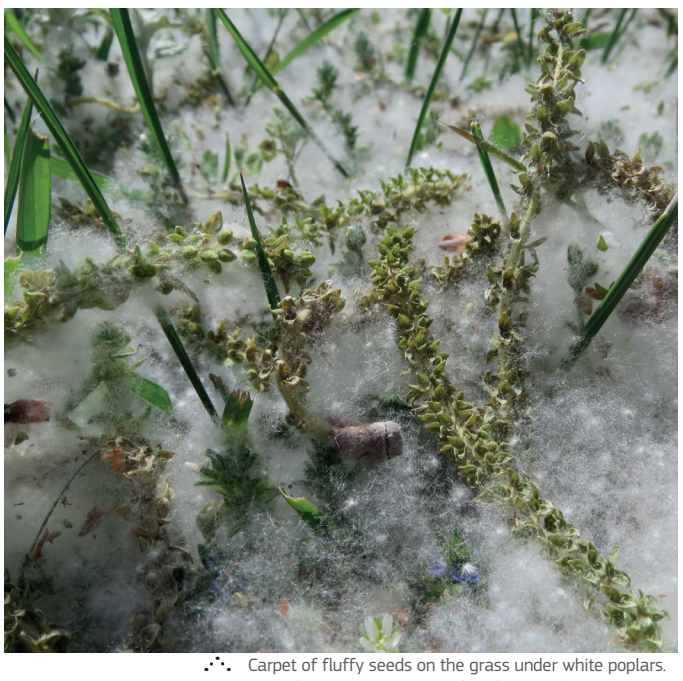

Carpet of fluffy seeds on the grass under white poplars.
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