Pubescent oak

Quercus pubescens

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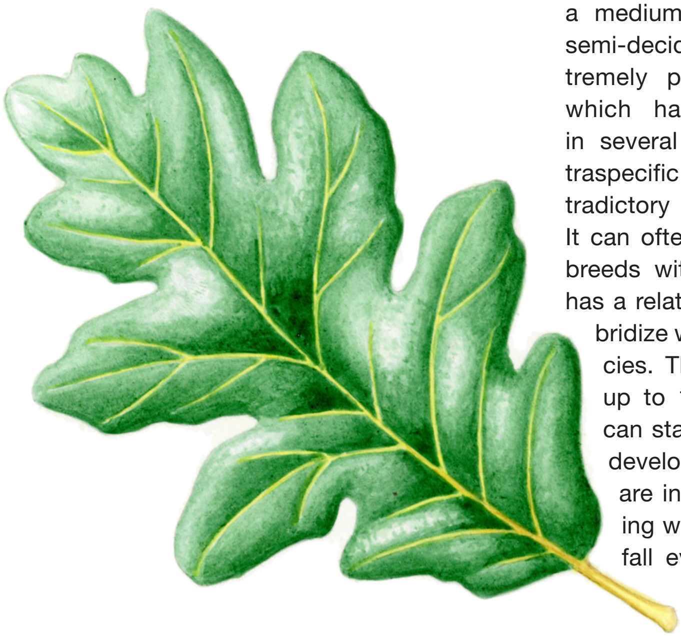
These Technical Guidelines are intended to assist those who cherish the valuable pubescent oak genepool and its inheritance, through conserving valuable seed sources or use in practical forestry. Due to its complex taxonomic status the guidelines discuss the species *sensu stricto*. The focus is on conserving the genetic diversity of the species at the European scale. The recommendations provided in this module should be regarded as a commonly agreed basis to be complemented and further developed in local, national or regional conditions. The Guidelines are based on the available knowledge of the species and on widely accepted methods for the conservation of forest genetic resources.



Biology and ecology

Pubescent oak (*Quercus pubescens* Willd.) is native to Europe and Asia Minor. It is a medium-sized deciduous or semi-deciduous tree and an extremely polymorphic species, which has been subdivided in several subspecies and intraspecific taxa with often contradictory taxonomical validity. It can often be found in crossbreeds with other oaks and it has a relative high ability to hybridize with various oaks species. The species can grow up to 15 m in height, or it can stay as a shrub. Leaves develop early in spring and are incompletely shed during winter: sometimes they fall even at the beginning of spring. In exceptional cases, trees can keep green leaves throughout winter, even in the northern part of the distribution range. Buds are ovate-acuminate, greyish-brown and tomentose.

Fertility starts at relatively young age, when the trees are 10–15 years old. The flowering begins in April–May. Fruits are sub sessile or shortly stalked, and clustered in groups of 3 to 4 acorns. The maturation of the acorns is annual (October) and the germination capacity of the acorns is strong and fast, similar to *Q. petraea.*

Quercus pubescens is one of the most xerophilous deciduous oak species, with a marked preference for chalky soils. It grows between 200–1,500 m. above sea level, mostly on sunny slopes. The species is well adapted to many different kinds of soils and also to rocky and dry sites. It is a sub-Mediterranean species; fairly resistant to winter cold and it requires high summer temperatures with little rain. Its growth is not particularly fast; a long winter dormancy allows avoidance of late spring frosts. Its resprouting capacity is excellent.

Distribution

Q. pubescens has a wide distribution range which includes most of central and southern Europe; it is one of the most important forest tree species in south--central and –south eastern Europe and Anatolia.

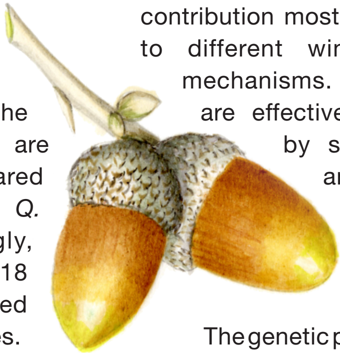
The habitats of *Q. pubescens* are generally characterized by very low precipitation (<400 mm in the vegetation period), medium-long summer drought, temperatures in the coldest winter months in the range of 0 to 5°C (but it is more sensitive to frost than *Q. petraea*) and very poor forest soils or eroded soils. Very old trees are rarely reported since its habitats are commonly coppiced. Its life cycle is estimated at 200–400 years.

Importance and use

The wood is similar to that of *Q. petraea*, with ring porosity, yellowish sapwood and brown heartwood; it is strong and resistant, but very heavy and shrinkable. It is used in nautical manufacture, for farm tools and utensils, firewood and charcoal. Despite its high adaptability to environmental factors, *Q. pubescens* is not grown for trade. However, drought tolerance and its ability to thrive in poor soils and its often attractive habits make *Q. pubescens* in practice commonly used in urban areas in Mediterranean regions. *Q. pubescens* can be effectively used in the establishment of economically attractive truffle orchards, or trufferies. Truffles grow in ectomycorrhizal association with the tree's roots.

Genetic knowledge

The diploid chromosome number of the pubescent oak is 2n=24. Intraspecific genetic diversity has been poorly investigated. A survey of chloroplast DNA diversity in Europe (Petit et al. 2002a) investigated 331 populations of *Q. pubescens* s.l. (incl. *Q. virgiliana* stands) and found 14 out of 33 haplotypes (chloroplast genotypes) reported in 2613 oak populations across Europe. In *Q. pubescens* stands, haplotypes 1, 2, 5, 7, 10, 11, 12, 17 were the most common which are most frequently shared with *Q. petraea* and *Q. robur.* Interestingly, haplotypes 3 and 18 were only represented by pubescent oak trees.



During the last ice age, the oak natural ranges were mainly restricted to the Iberian, Italian and Balkan peninsulas. During the postglacial period (approximately the last 7000 years) oak has recolonized its modern-day range. The subsequent recolonization by various post-glacial migration routes has left a genetic trace revealed by chloroplast DNA. These movements have basically impacted the chloroplast genetic diversity distribution (Petit et al. 2002b). Theoretically, the taxonomic complex of the most common oaks (*Q. robur*, *Q. petraea* and *Q. pubescens*) must have had the most intensive role in the recolonization of oaks in Europe. For instance, only 4 out of 33 haplotypes were not found in populations composed of these 3 widespread species.

The effective pollen dispersion of white oaks has been measured by using parentage analysis. In *Quercus* species, an effective pollen flow was reported. Pollen dispersion curves are clearly composed of a short and a long distance contribution most likely related to different wind transport mechanisms. The acorns are effectively dispersed by small rodents and birds (e.g. European jay, *Garrulus glandarius*).

The genetic potential of the Mediterranean oak populations (basically composed of *Q. pubescens*, *Q. virgiliana* and *Q. pyrenaica*, plus *Q. faginea* on the Iberian Peninsula) might assure a continuous gene flow from south to north into the temperate oak populations in Central Europe. With respect to predicted global warming, pubescent oak populations and their gene pool might be an important genetic resource for European white oaks in the future. Genetic studies made on local populations are proposed to improve genetic knowledge on the species.

Threats to genetic diversity

Most pubescent oak forests have been overharvested and overgrazed since the start of human civilization. Its natural distribution range has been strongly reduced in the past and now these areas are usually used for plantations (olive trees, fruit trees, vineyards, etc.) Climate change, indiscriminate cutting, erroneous silvicultural management (coppices or clear cuttings over large areas, where regeneration cannot thrive, use of exotic reproductive material, etc.), fires, overgrazing or intensive game management (especially during the regeneration period) can threaten the genetic diversity. The species frequently suffers from strong defoliation damage caused by *Tortrix viridana* L. (European oak leafroller), *Taumetopoea processionea* L. (oak Processionary), and *Lymantria dispar* L. (Gypsy moth). When this happens, the defoliation might increase the risks of the human or ecological factors mentioned above which threaten segmented *Q. pubescens* populations.

Guidelines for genetic conservation and use

Similarly to other related oak species, *in situ* conservation methods should generally be preferred also for *Q. pubescens.* Pubescent oak grows well in a high-forest system which would by itself be an effective measure for species protection. Nevertheless, due to its good resprouting ability, the coppice system has been predominantly used for ages. Decrease of genetic resources is a serious risk when concentrating exclusively on coppices. This system, with 1000–2000 stumps/ha, coppicing rotations of about 30–50 years and preserving at least 80 seed-bearing trees/ha, is suggested for small private farms, and where the soils are degraded, or with incompletely favourable ecological conditions.

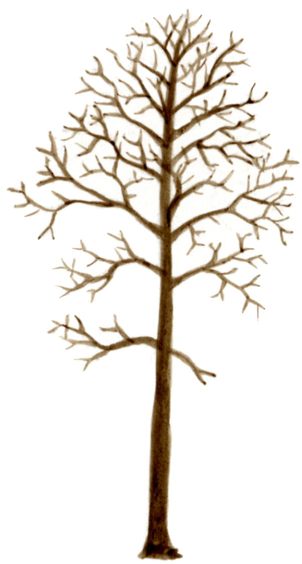
Coppice conversion to high forests requires 170–200 seed-bearing trees/ha. A good compromise would be to leave 80–130 stumps with just one single stem and adopt longer rotations for coppicing (50–80 years).

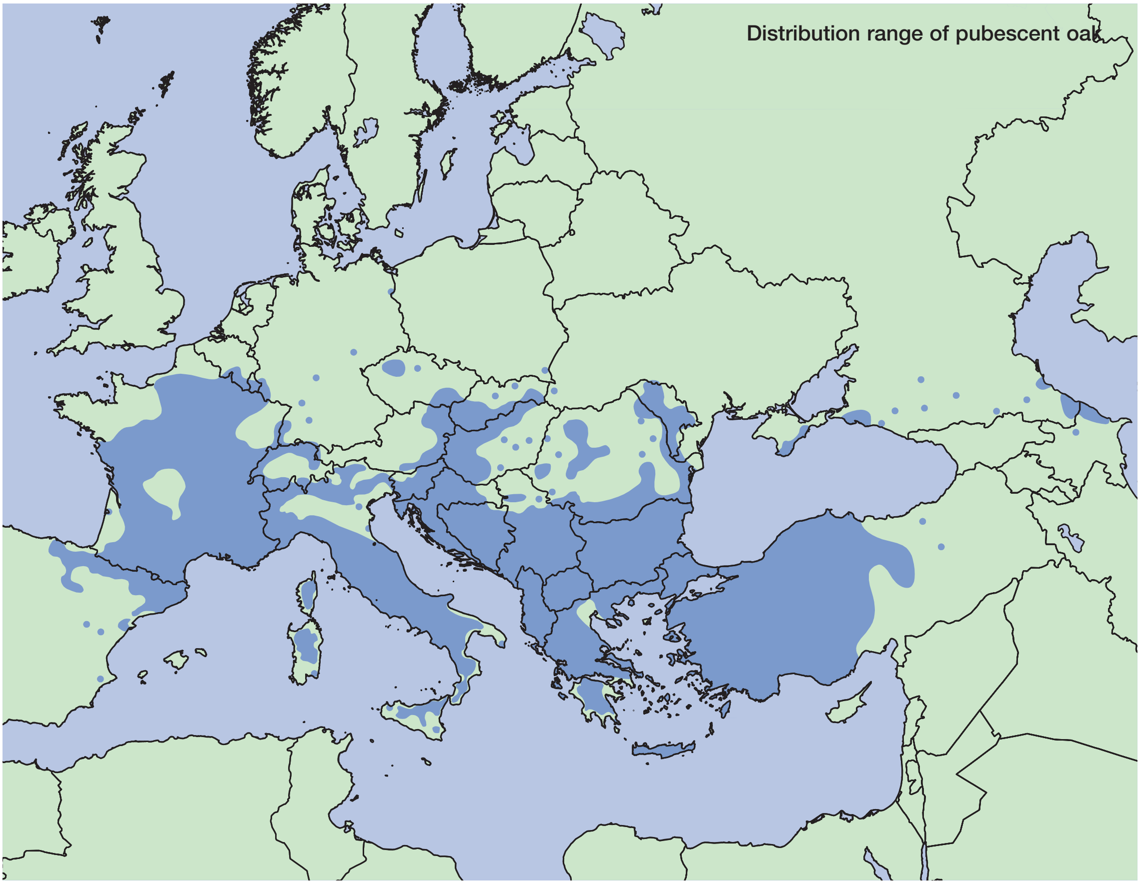
When artificial regeneration is carried out according to the principles of genetic conservation, then the following requirements for the use of reproductive material must be observed:

- Preference should always be given to local material, unless results from provenance trials point to inferior quality or growth characteristics in the local population. Local material usually guarantees retention of the evolutionary and adaptive characteristics that have developed at a given site under specific conditions over generations. Lack of adaptability can lead to serious failures at any stage of the long lifespan of oaks and other forest tree species.
- If there is no local material available or if there are signs of inbreeding, then restoration may rely on the introduction of material from outside. Material from localities sharing the site conditions with the regeneration site should be preferred.

If *in situ* methods are not sufficient, additionally, *ex situ* conservation programmes should be used as well in order to preserve the endangered gene pool. *Ex situ* programmes should be adapted and specified to the local conditions to incorporate genetic conservation criteria into forestry management in order to guarantee the genetic quality of the materials used in plantations.

Pubescent oak might have an increasing role in its present and potential future distributional range, due to its adaptive potential. The forest-steppe and sub-mediterranean climate is predicted to be the dominant climate in some regions of Central Europe. In such climatic belts the forests are usually composed of *Q. pubescens* s.l. and/or its natural hybrids. Since limited genetic information about *Q. pubescens* is available, it is recommended that genetic conservation programmes start with the following objectives: conservation of endangered, marginal populations and habitats of *Q. pubescens*; sampling the genetic diversity; establishment of Dynamic Conservation Units based on long term autochthony, high biodiversity value and location in ecologically diverse regions of large populations (> 1000 individuals).




Distribution range of pubescent oak

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EUFORGEN

This series of Technical Guidelines and distribution maps were produced by members of the EUFORGEN Networks. The objective is to identify minimum requirements for long-term genetic conservation in Europe, in order to reduce the overall conservation cost and to improve quality standards in each country.

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