Turkey oak

Quercus cerris

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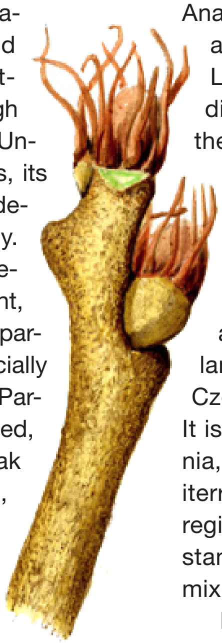
These Technical Guidelines are intended to assist those who cherish the valuable Turkey oak gene pool and its inheritance, through conserving valuable seed sources or use in practical forestry. The focus is on conserving the genetic diversity of the species at the European scale. The recommendations 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

Turkey oak (*Quercus cerris* L.) is native to Europe and Asia Minor and exhibits strong morphological variability and ecological adaptability. It has deciduous leaves and ovoid acorns with big curly cups, which ripen in the second year (September–October). It may reach 30–35 m in height, with a straight trunk up to 2 m in diameter and 5–5.5 m in circumference. The crown is oval, broad and open.

The bark is thick, rough and deeply furrowed into irregular horizontal and vertical ridges. The inner part is characteristically red. Leaves are yellow-green, with 6–12 triangular narrow lobes and deep incisions on each side. The regularity of the lobbing varies greatly, with some trees having very regular, moderately to deeply incised lobes (var. *Haliphleos* and *Cerris*), while others are just toothed (var. *austriaca*). Leaves are shed in October.

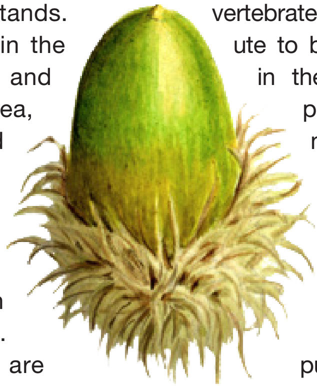
Turkey oak is characterized by mesophilous-subcontinental behaviour. It is water-demanding and moderately resistant to low and high thermal extremes. Under xeric conditions, its competitive ability decreases perceptibly. The species is heliophilous; in full light, the growth rate is particularly fast, especially that of the sprouts. Partial shade is tolerated, however. Turkey oak prefers basic, deep, fresh soils, but it is highly tolerant to almost any soil (except very wet soil). Turkey oak also tolerates strong winds, but not maritime exposure. It forms both pure and mixed stands, mainly with other oaks. Pure populations with an anthropic origin are common. It may show a sporadic occurrence in Mediterranean evergreen forests, where summer drought is not a limiting factor. *Q. cerris* is found from the lowlands up to about 1500 m above sea level, in Anatolia mostly between 500-2000 m, in Lebanon between 1300 and 2200 m.



Distribution

Turkey oak is a very important forest species in south-central and eastern Europe and Anatolia; it occurs as far south as the mountains of south Lebanon/northern Israel. Its distribution is centred round the lower parts of the Danube Basin, in Croatia, Hungary and around the Black Sea. The western limits of its range are in France, while the northern limits run across southeast Switzerland, eastern Austria, northern Czech Republic and Slovakia. It is widely distributed in Slovenia, especialy in the sub-Mediterranean and pre-Pannonian regions, in predominantly pure stands and as single trees in mixed broadleaf stands.

It is common in the Italian peninsula and in the Balkan area, from Croatia and southern Austria to Hungary, up to northern Greece and the Bulgarian and Romanian Black Sea coasts. In Turkey there are two different subspecies. It also occurs in south and east Anatolia (reaching Erzincan), up to Samsun in Northern Anatolia and the Aegean coast of Turkey.



Importance and use

Due to its relatively fast growth, Turkey oak is widely planted and it is naturalized in much of Europe. It is used as ornamental in parks and gardens, and as windbreak. The timber has no valuable technological properties; it is prone to cracking and splitting and hence commonly used for fencing, fuel wood and charcoal, owing to the strong re-sprouting ability of its coppiced stands. In the past, it was widely used for railway sleepers, now these remains only for a small proportion of the logs final destination. Indeed, the current importance of *Q. cerris* relies in its major ecological role. Turkey oak has diverse types of interactions with ectomycorrhizal fungi, gall-forming insects and seed-eating vertebrates. Its forests contribute to biodiversity safeguard in the temperate regions providing habitats for numerous plant and animal communities, including vertebrates, arthropods, greens and epiphytes.

It is possible to see pure managed stands and mixed forests with different *Quercus* species (*Q. frainetto, Q pubescens, Q. infectoria, Q. petrea, Q libani*), other broad leaved species (*Fagus, Castanea, Carpinus*) and conifers

(*Pinus nigra, Pinus brutia, Pinus pinea*). There are also monumental individuals with symbolic value widely occurring in many old villages across Europe as part of the local heritage.

In past times, the seeds were cooked, dried, ground into powder and used as a thickening agent in stews or mixed with cereals for bread-making. The seed contains bitter tannins, which can be leached out by washing the seed thoroughly in running water. The roasted seeds were also used as a coffee substitute. Other uses concern the seed cups, leaves, bark and wood, commercially used as a source of tannins. Finally, *Quercus cerris* can be efficiently used in the establishment of truffle orchards, or trufferies. Truffles (*Tuber melanosporum* Vitt., *T. magnatum* Pico, *T. aestivum* L.) grow in an ectomychorrizal association with the tree's roots.

Genetic knowledge

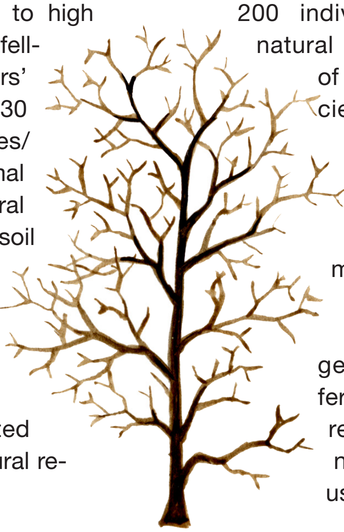
It is commonly agreed that, during the last ice age, the natural range of oak species was mainly restricted to the Iberian, Italian and Balkan peninsulas. During the postglacial period (approximately the last 7000 years), oaks recolonized their present range from the different refuge areas. These movements have basically impacted the genetic diversity distribution. Accordingly, recent data based on plastid microsatellites across the whole species' range show an important level of population divergence, with the highest genetic diversity within the Balkan area and the presence of unique lineages in the far eastern range (Bagnoli et al. 2016). Three genetically and geographically distinct clusters were identified: a Western (Italian peninsula and Northwestern Balkan region), a Central (Central and southern Balkans), and an Eastern group (Anatolia and Middle East). Fossil data and approximate Bayesian computation analysis indicate a possible bottleneck leading to the divergence of the Eastern and Central populations in the Early Pleistocene. The split between the Italian and Balkan populations was probably caused by a marked population contraction during a glacial phase of the Middle Pleistocene. In Italy, *Q. cerris* shares the two most common haplotypes with *Q. suber*, thus indicating the possible retention of ancestral variation or unidirectional introgression between Turkey oak (as seed parent) and cork oak (pollen parent). In Anatolia, an extensive investigation with nuclear microsatellites revealed the occurrence of two different gene pools, with low and high genetic diversity (the northern and south-central region, respectively). The false cork oak (*Quercus crenata* Lam.), scattered in Italy, southern France, Slovenia and Croatia is considered the resulting hybrid between *Q. cerris* and the cork oak (*Quercus suber* L.). Based on morphological intermediacy and some preliminary genetic studies, other less frequent hybrids are those suggested with other eastern Mediterranean oaks such as *Q. libani* Oliv. (*Q. x libanerris* Boom.), *Q. trojana* Webb. (*Q. x schneideri* Viehr.), *Q. pubescens* (*Q. x baenitzii* A.Camus), *Q. brantii* Lindl., *Q. infectoria* Oliv. and *Q. ithaburensis* Decne. (Özer, 2014). However, a clear assessment of the hybridization ability of the Turkey oak and validation of its presumed hybrids are still missing.

Threats to genetic diversity

Humans have greatly reduced the natural distribution of oaks in the past, and most oak forests have been managed for millennia. Due to the good resprouting ability, *Q. cerris*, was commonly managed as coppice. Indiscriminate cuttings, inappropriate silvicultural management, fires, overgrazing (especially during regeneration), mining activities and climatic changes also constitute a threat. In order to allow the species to adapt, fragmentation of stands and low numbers of viable and reproducing individuals should be avoided, whereas natural gene flow via pollen and acorns should be favoured.

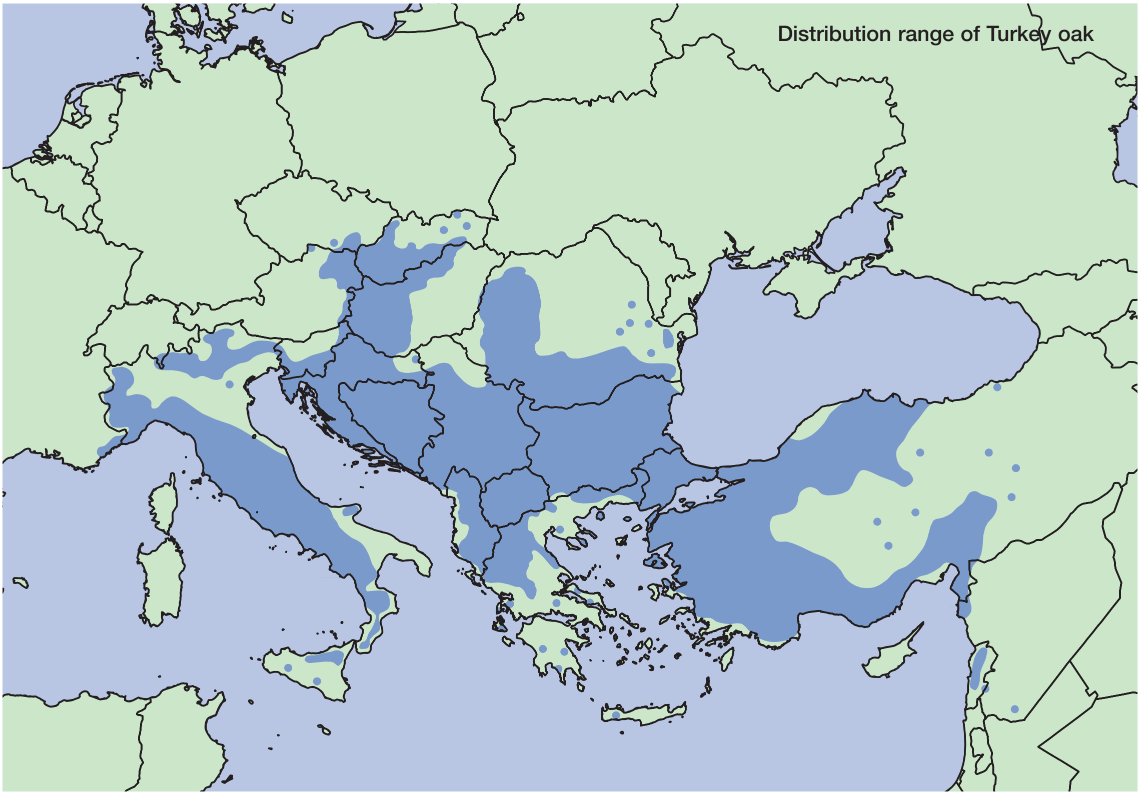
Guidelines for genetic conservation and use

Concerning *Q. cerris* wild populations, special care should be taken regarding habitat conservation, soil protection and water regime management. As for managed stands, *Q. cerris* grows well within a high forest system, which would in itself be a good measure for the species protection. To preserve soil fertility and increase stand biodiversity, traditional coppice systems, performed with short rotation regimes (20 years), should be replaced by longer rotation time periods of about 25–30 years, with 1000–2000 stumps/ha and preserving at least 80 seeding trees/ha. This practice is suggested especially to small private farms, and where the ecological conditions are not completely favourable. Coppice conversion to high forests requires a felling after 50–80 years' delay, leaving 80–130 seed bearing trees/ha, if there are optimal conditions for natural regeneration (good soil fertility, low density of healthy standards), or 30-50 years and 170–200 seed bearing trees/ha in over-exploited stands or where natural regeneration is poor.



In high forests for production, even-aged populations are preferred, in order to reduce competition among individuals of different sizes. Since Turkey oak wood is not valuable, high forest management, with shelter wood felling on small areas and short periods dedicated to regeneration, is the management system generally adopted. Where regeneration is naturally poor, working the soil (superficially), removing the understorey and plantation of new seedlings are good options. Grazing should in any case be avoided. For natural regeneration, 70–80 seed bearing trees/ha (80–150 with diameter < 50 cm), should be preserved at every felling. Thinning should be performed between 80 and 100 years. After 150 years, the only care suggested is to remove damaged and unhealthy individuals. Mixed forests with 150-200 individuals/ha and natural co-occurrence of native tree species should be pursued.

For *Q. cerris*, *in situ* conservation methods based on natural regeneration are generally preferred. If natural regeneration is not sufficient, the use of non-native



reproductive material can be only exceptionally accepted, and it should be transferred only at a local scale, based on the detected species' genetic structure. Transfers among provenance regions must be strictly avoided.

If *in situ* methods are not sufficient, an *ex situ* conservation programme should also be applied to preserve the endangered gene pool. *Ex situ* programmes should be adapted to local conditions, such as population structure; forestry practices; economic, political and social situations, etc.

In the case of intensive use of forest reproductive material (FRM)—acorns, seedlings raised or lifted—the rules and requirements of EC legislation for FRM and/or OECD Forestry Scheme shall be primarily applied or adapted.

Due to its adaptive potential, Turkey oak might have an increasing role in present and future sub-Mediterranean regions, which may be important in the context of climate change. Given the genetic information available, it is recommended that conservation programmes start with the following objectives: conservation of endangered, marginal populations and habitats of *Q. cerris*; protection of the identified genetic variants; establishment of Dynamic Conservation Units based on long term autochthony, high biodiversity value and location in ecologically diverse regions of large populations (> 1000 individuals).

EUFORGEN

Quercus cerris **Turkey oak**

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

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