Hungarian oak

Quercus frainetto

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These Technical Guidelines are intended to assist those who cherish the valuable Hungarian oak genepool 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.

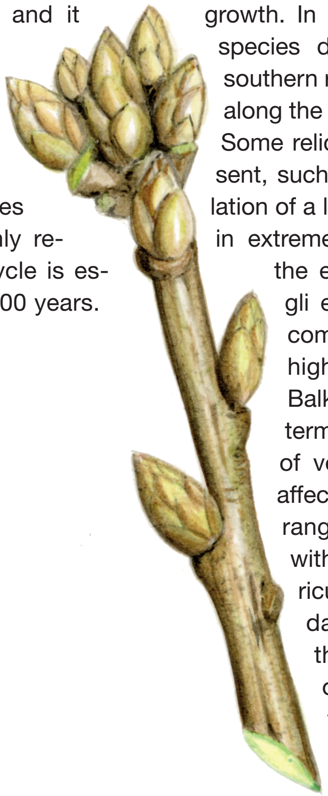
Biology and ecology

Hungarian oak (*Quercus frainetto* Ten., syn. *Q. conferta* Kit.) is native to southeastern Europe and Asia Minor, and belongs to *Quercus* L. subgen. *Quercus sensu* Schwarz (1936–39), or Sect. Mesobalanus, Subsect. Macrantherae sensu Camus (1936–54). The latest taxonomic systems divide the genus *Quercus* in two subgenera: subgenus *Euquercus* and subgenus *Cyclobalanopsis*. The subgenus *Euquercus*, now called subg. *Quercus*, has been further subdivided into four sections: *Rubrae*, *Protobalanus*, *Cerris* and *Quercus. Q. frainetto* belongs to this last one, which is commonly referred to as 'white oaks'. It is an imposing, long-lived, deciduous tree, that can grow up to 40 m in height, with a diameter of over 1 m. with a straight trunk and a broad, dense crown. The bark is smooth in young trees (10–12 years old), then it breaks into small, flat, dark brownish-grey scales. Twigs are grey, initially tomentose, then glabrous. The leaves are alternately arranged, 10–20 cm long and 5–12 cm wide, crowded towards the apex of the twig, obovate shaped, with an often lobed (auricled) base, deeply segmented with 7–9 pairs of oblong (often sub lobed) lobes. They are initially pubescent on both sides, then only underneath with grey or brownish hairs; the lateral veins (8 or more) are parallel, with few or no intercalary veins and the reddish petiole is 2–6 mm.

Green male and female flowers are in separate clusters on the same tree (monoecious). Male flowers are on small, 4–5 cm long catkins. The female clusters are denser. Acorns are oblong, egg-shaped (2–2.5 cm), glabrous, with big curly cups, the ripening is annually and they mature in the first half of October. The peduncle is very short (< 2 mm) or even absent with groupings of 2 to 7 acorns. The cup (involucre) is hemispherical, protecting a third to half of the acorn, scales are oblong, pubescent, appressed and loosely imbricate.

Natural hybrids of *Q. frainetto* are not common but some individual hybrids have been reported with other species of the *Quercus* subgenus such as *Q. petraea* or its relative taxa.

The species is highly light-demanding and basically thermophilous, with a moderate climatic range, and requiring appropriate atmospheric humidity and fertile, preferably alluvial silica or lime soils. In fact, the habitats of *Q. frainetto* stands are generally characterized by precipitation exceeding 900 mm/y, short summer drought, temperatures in the coldest winter months in the range of 0 to -5°C (but more sensitive to frost than *Q. petraea*) and acidic soils. Although the species is considered to have relatively fast growth, *Q. frainetto* is not competitive. Its intensive height growth usually stops at 60–80 years of age, especially in secondary soils, and it may easily be outcompeted by other oaks, owing to regeneration difficulties. Very old trees are not commonly reported; its life cycle is estimated at 200–400 years.

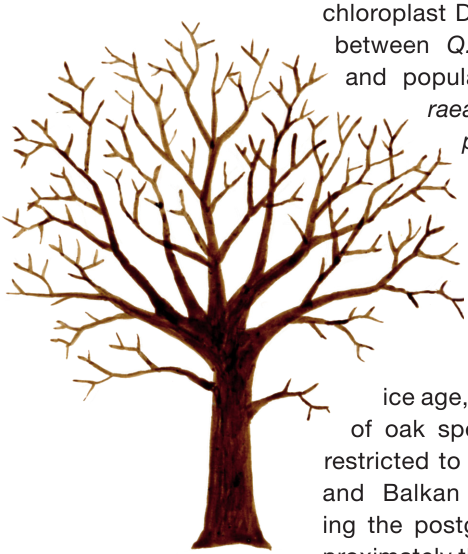


Distribution

Quercus frainetto has a south-east European distribution. It occurs mostly in the Balkan Peninsula, in southern Italy and Northern Anatolia. It is widespread in Slovenia, Bosnia, Bulgaria, Croatia, Serbia, Romania, Italy, Albania, Greece and Turkey. Interestingly and despite its name, in Hungary the species might not be native and occurs only in artificial stands. The centre of the natural range is the Balkans, where the species is stand forming. It is mainly used for forestry in Italy, Romania and Bulgaria, especially due to its excellent resprouting and relatively fast growth. In Italy, the bulk of the species distribution is in the southern regions and scattered along the pre-appeninic ridges. Some relic stands are still present, such as a remnant population of a large forest destroyed in extreme south of Apulia at the end of 1700s (Medagli et al 1990). It is also common in the medium-high mountains of the Balkan Peninsula. Long-term human disturbance of vegetation has widely affected the *Q. frainetto* range, which coincides with most historical agricultural areas. Present day discontinuity in the distribution area of the species might therefore be mainly anthropogenic.

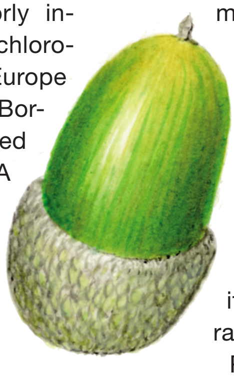
Importance and use

Though valuable for handicrafts (e.g. furniture, barrels and ship construction), Hungarian oak is mainly used for firewood. In many ways the quality of its wood is comparable with that of sessile oak, to such a point that sometimes it is even fraudulently substituted for this more prestigious oak species. The tree's bark is a commercial source for tannin. Its sweet acorns have been used to feed animals. Although acorns can be frequently harvested, production of reproductive material is not significant, due to the dominant use of natural regeneration. It is also considered a valuable ornamental tree for urban architecture. *Q. frainetto* is not covered by any protection and studies on its biology and ecology are scarce.



Genetic knowledge

The diploid chromosome number of the Hungarian oak is 2n=24. Intra-specific genetic diversity has been poorly investigated. A survey of chloroplast DNA diversity in Europe (Fineschi et al. 2002, Bordács et al. 2002) showed that the specific cpDNA haplotypes of the Italian and Balkan peninsulas (haplotypes 5, 6, 7, 13, 15, 16, 17, 19 and 30) are the most common in the Hungarian oak stands. Interestingly, haplotype 19 was only found in *Q. frainetto* (pure or mixed) stands in Italy. On the contrary, haplotype 2 which is common in this part of Europe was not found for *Q. frainetto*. The studies revealed a high sharing of chloroplast DNA polymorphism between *Q. frainetto* stands and populations of *Q. petraea*, *Q. robur* and *Q. pubescens* on the Italian and Balkan peninsulas. Most of the variation reported was located in the Balkans.



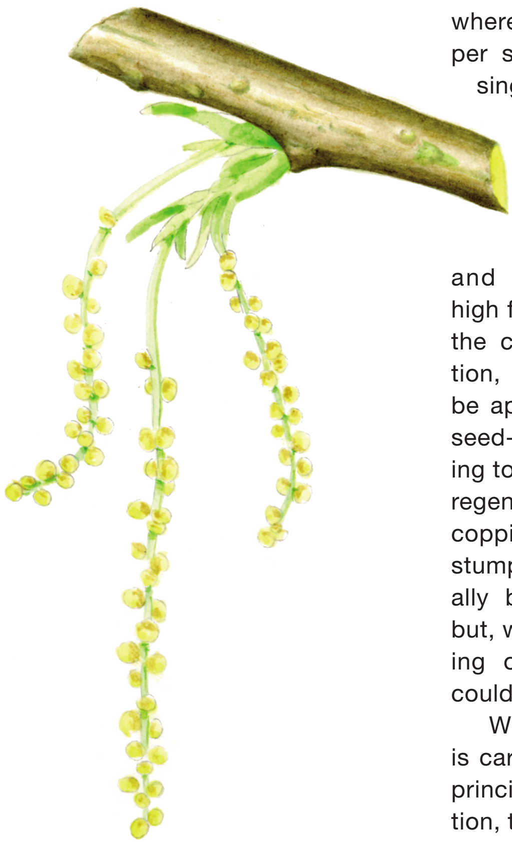
During the last ice age, the natural ranges of oak species were mainly restricted to the Iberian, Italian and Balkan peninsulas. During the postglacial period (approximately the last 7000 years) the species recolonized their present range, which has left a genetic trace from the different refugia. These movements have impacted the chloroplast genetic diversity distribution (Petit et al. 2002) modelled by cpDNA markers. In the recolonization of oaks in Europe, *Q. frainetto* might have a less intensive role due to its small distribution area, restricted to south-eastern Europe, and its specific Mediterranean character.

Pollen dispersion of white oaks has been measured by using parentage analysis, and an effective pollen flow has been reported in populations composed of most of the oak taxa distributed in Europe. 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 (European jay, *Garrulus glandarius*).

Regarding predicted climate changes, the genetic potential of *Q. frainetto* populations might have a relevant role in assuring a continuous gene flow from south to north into the temperate oak populations in Central and Eastern Europe. Genetic studies made on local populations are proposed to improve genetic knowledge on the species.

Threats to genetic diversity

Humans have strongly reduced the natural distribution of oaks in the past, and most oak forests are managed. Climate change, indiscriminate cutting, erroneous silvicultural management (coppices or 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) are a realistic threat to the genetic diversity of *Q. frainetto.*



Guidelines for genetic conservation and use

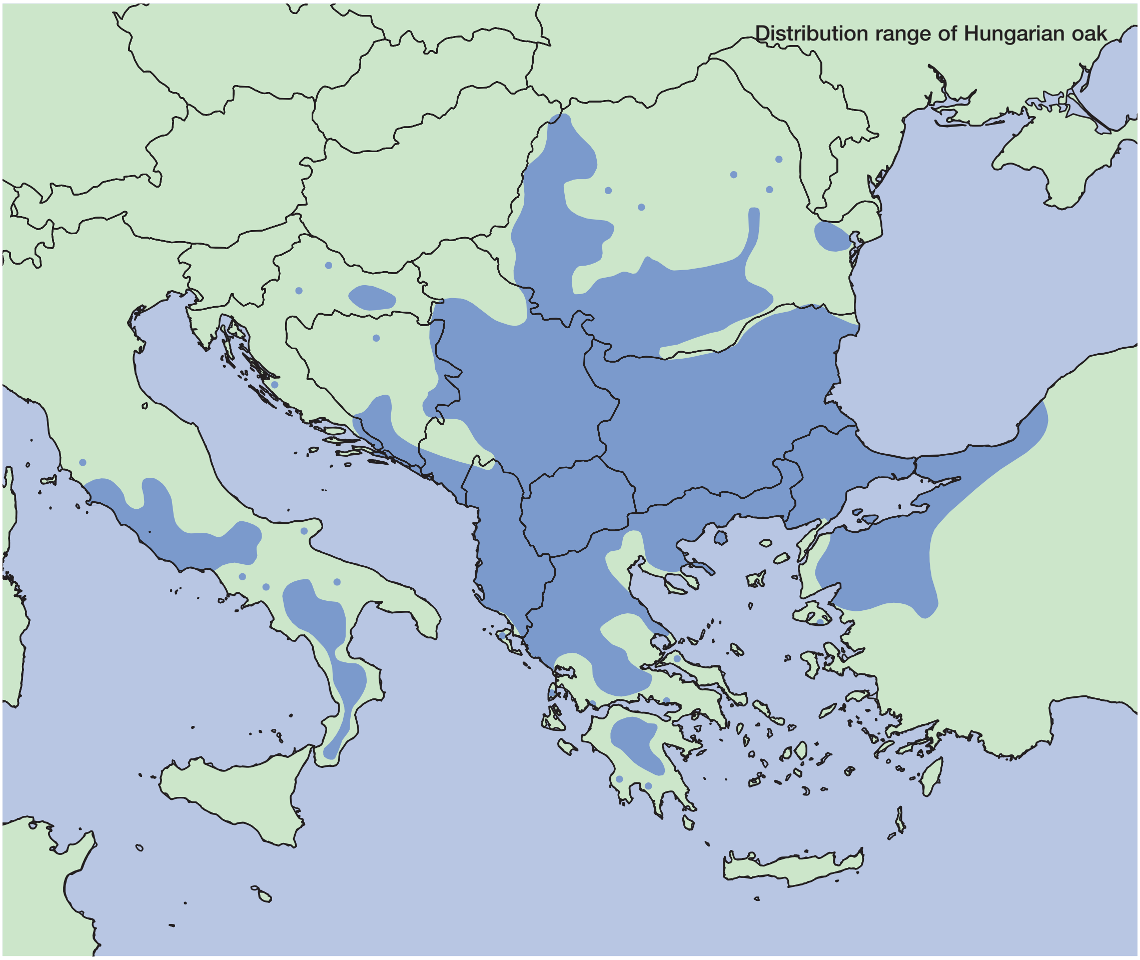
For *Q. frainetto*, as a stand forming oak species, in situ conservation methods based on natural regeneration should generally be preferred. Hungarian oak usually grows in mixed stands with *Q. cerris* and *Q. petraea* and, due to their good resprouting ability, the coppice system has been predominantly used for ages. However, after a fast initial growth, accompanying species often overgrow and suffocate it. On the contrary, *Q. frainetto* grows well with high forest or in a coppice system where the number of stems per stump is reduced to one single stem, which would be by itself a good measure for the species' in situ protection. It is recommended to convert coppiced *Q. frainetto* and *Q. cerris* mixed stands to high forests for 80–90 years. In the case of natural regeneration, a special method should be applied, by leaving 80–150 seed-bearing trees/ha (according to the size of the plants) for regeneration. High forests and coppice with single stems per stump of *Q. frainetto* can usually be regenerated naturally, but, when needed, direct seeding or planting of seedlings could also be applied.

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 Hungarian oak 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, *ex situ* conservation programmes should be used as well in order to preserve the endangered gene pool. *Ex situ* programmes should be adapted 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.

Due to its adaptive potential, Hungarian oak might have an increasing role in present and future sub Mediterranean regions, which may be important in the context of climate change.



Since limited genetic information about *Q. frainetto* is available, it is recommended that genetic conservation programmes start with the following objectives: conservation of endangered, marginal populations and habitats of *Q. frainetto*; sampling the genetic diversity; establishment of Genetic Conservation Units based on long term autochthony, high biodiversity value and location in ecologically diverse regions of large populations (> 1000 individuals).

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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The distribution map is based on: Caudullo, G., Welk, E., San-Miguel-Ayanz, J., 2017. Chorological maps for the main European woody species. Data in Brief 12, 662-666. https://doi.org/10.1016/j.dib.2017.05.007

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