

Some marginal populations of Holm Oak (*Quercus ilex* L.) in France

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Introduction

The Holm oak (*Quercus ilex* L.) is a species which is present in the South and Southwest of France, and its populations are considered among those growing under the harshest of ecological conditions. The Atlantic populations are in fact those located at the northern limit of the natural distribution of the species.

After recapitulating the morphological characters and the ecological requirements of the Holm oak, this article goes on to describe some populations which are marginal in terms of their geographical location and site characteristics. This polymorphic species is adapted to very different ecological conditions. It will be possible to monitor these populations developing dynamically in response to both recent and future climate modifications.

Morphological characteristics

Systematically the Holm oak (*Quercus ilex* L.) belongs to subgenus *Quercus*, section *Quercus*, the so-called white oaks. It is a very polymorphic species both with respect to its general aspect and to its vegetative structures relative to conditions at the sites where it grows. Its height thus varies between fifteen and thirty m with a maximum trunk girth of two m wherever the soil is sufficiently moist or where it benefits from a maritime climate. Its top is therefore spreading and spherical, while the trunk is generally short and thick (Le Hardÿ de Beaulieu *et al.*, 2007).

The species can also assume the aspect of a flattened suckering shrub, hardly exceeding 2 m in height, a bit like *Quercus coccifera* L, the Kermes oak of limestone scrubland. Its foliage persists from three to four years. The mature bark is rather thin and in the form of small scales more or less quadangular in shape. The twigs display a dense whitish-gray tomentum which often persists until the second year. The buds are small, round or somewhat ovoid, tomentose and possessing stipules which are quickly shed.

As to foliage, the Holm oak is probably one of the most polymorphous species in the world, including on the same individual or the same branches. The lamina is elliptical and almost orbicular. It measures 2.9 cm long by 1.6 cm wide. The leaf margin is entire or endowed with acuminate, mucronate, or wavy teeth/lobes. When the leaves unfold they are covered with an ashen gray or whitish gray tomentum on both surfaces; the upper surface becomes dark green, shiny

and usually quite glabrous while the lower surface is covered with a fine but dense whitish or grayish tomentum. There are from seven to twelve secondary veins. The petiole is very tomentose and its length is between 0.3 and two cm. The caps are campanulate to almost hemispheric, from 0.7 to 1.7 cm in height by one to 1.5 cm in width. They cover between a third and a half of the acorn. They are composed of tomentose, grayish scales, small and imbricate. The acorns are ovoid to globular, 1.5 to 3.5 cm high by one to 1.5 wide. They are solitary or arranged at most in groups of three on a fruiting peduncle measuring between 0.8 and five cm in length. The acorns ripen in a single season. The first crop is produced toward the age of twelve years and acorn production is abundant and regular until an advanced age. The size of the crop is tied to the amount of precipitation in the preceding autumn.

The Holm oak hybridizes with *Q. coccifera* L., *Q. pubescens* Willd., *Q. robur* L., *Q. rotundifolia* Lam., and *Q. suber* L.

Ecology

The Holm oak is adapted to a great variety of soils because it is indifferent to soil chemistry. Thus it is found on limestone soils which may or may not be decarbonated, compacted or loose, marly or alluvial, sandstone, schist, basalt, dry soils or such as are somewhat wet but readily draining (Rameau *et al.*, 2008). On poor or dry soils its growth is slowed. The presence of rocks or pebbles makes no difference. It prefers, nevertheless, terrain which is permeable and somewhat compacted. In the mountains it prefers slopes with a southern exposure.

The Holm oak grows from sea level to 2900 m in North Africa. Very tolerant with respect to soil, the same applies with respect to light, even if, as is well known, its development is maximal in the absence of forest cover. Nevertheless, it tolerates rather well the shade of cedars, beeches and pines. Although it loves heat, the Holm oak is not properly speaking a typical Mediterranean species, even though it moves in quickly after a fire. In essence, it is both Mediterranean and South Atlantic in nature. It therefore attains its most attractive dimensions close to the ocean and particularly in a maritime climate as is shown by its size in cultivation, notably in the United Kingdom.

The Holm oak endures summer dryness and the variations of Mediterranean climate without difficulty, as well as intermittent winter cold and prolonged summer dry spells. Depending on its situation, it lives with an annual rainfall of between 250 and 1000 mm, but it does not like regions which are cold and humid at the same time. It is not bothered by snow. It is a robust, vigorous and adaptable species, accepting of dry summers thanks to its tap root with well-developed ancillary roots, penetrating to a depth of ten meters according to Aimée Camus (1936-39).

Among plants which are companions of *Quercus ilex* are the following trees and shrubs: *Pinus pinaster* Aiton, *Pinus halepensis* Mill., *Arbutus unedo* L., *Pistacia lentiscus* L., *Pistacia terebinthus* L., *Quercus coccifera* L., *Quercus pubescens* Willd., *Quercus suber* L., *Ostrya carpinifolia* Scop., *Acer monspessulanum* L., *Acer campestre* L., *Buxus sempervirens* L., *Cistus laurifolius* L., *Cercis siliquastrum* L. and *Cotinus coggygria* Scop.



Fig. 1
Range of the
Holm oak.

Natural distribution

The Holm oak is a native of southern and central Europe and of the Mediterranean Basin: Albania, Algeria, Greece (including Crete), Italy (including Sardinia and Sicily) Libya (north-east), Macedonia (south), Morocco, Portugal, Spain, Tunisia, Turkey, the former Yugoslavia (west). Its presence in Israel, Lebanon, Syria, and Cyprus is due to human action. From north to south, its area of distribution is between 32° and 47° north latitude to 7° 45' west to 33° east longitude. It is precisely in France that its most northern populations are located.

In France, natural populations are found on the west coast as far north as the Loire estuary, while in the south east, these occur along the Mediterranean coast in populations which tie together the Massif Central and the Pyrenees mountains from sea level to 1500 meters, reaching 1200 meters in Corsica.

Description of some marginal populations in France

Ore (Haute-Garonne): This population is located at a relatively low altitude (450-600 m) facing west south west. It is situated primarily in the National Forest (Fig. 2) of the Frontignes in the communes of Galié and Ore. This population and its associated flora are the object of management and specific kinds of protection. It is located barely fourteen kilometers north of the Spanish frontier and the Pyrenees Mountains, whose nearest high peaks reach 2193 m. Characteristics of the local climate are a mean annual temperature of 11.4° C and a moisture regime of 1191 mm maximum per year. The absolute minimum is -14° C and the maximum recorded temperature is 37.5° C. This forest was identified by the biogeographer Henri Gaussen, whose name is perpetuated in the specific epithet of a conifer (*Pseudotsuga sinensis* Dode var. *gaussenii* Silba) and who was the founder of the Jouéou Arboretum located close by; this arboretum is devoted to gymnosperms.



Fig. 2. Holm oak at Ore.

The flora which surrounds this population is temperate montane; but due to its exposure and its limestone substrate, there occurs in this very localized sector a Mediterranean flora analogous to plant communities of this type located more than 200 kilometers to the east. Thus, for the southwestern part of France, this population is one of the most distant from the Atlantic Ocean (190 km). (Fig. 3)

We are thus concerned with stations which are very localized and isolated, subject to microclimates which contrast notably with those of the immediate surroundings. Particularly frequent is the foehn effect. This phenomenon occurs when the wind, after crossing the Pyrenees, drops down north of the mountains bereft of its moisture, becoming then hot and dry.

Tourettes sur Loup (Alpes Maritimes): One of the most beautiful Holm oak populations in France is found in the Alpes Maritimes, more precisely in the valley of the Loup in the commune of Tourettes sur Loup. It is situated in a generally Mediterranean context, between 950 and 980 m. It grows in scree at the base of a high limestone cliff, below the Pic des Courmettes, which reaches a height of 1248 m.

The last time we visited these trees was in the autumn of 1999 during an IOS “Oak Open Days.” Some twenty individuals can be counted there whose circumference measures between 4 and 4.85 meters. The most interesting individual, called “Big Oak,” measures 5.4 meters in circumference. (Figs. 4 & 5) The height of the trees is important for the species, since they are between twenty and twenty-five m. These trees, survivors of an epoch when charcoal was produced, were spared the frequent coppicing connected with the production of charcoal, whose excellent quality was well known for this species. Their age has been estimated between 700 and 1,000 years, which would make them the oldest for this species in France. This is probably because of the shelter provided by their canopy while charcoal stacks were being assembled, but it is also possibly for reasons of acorn harvest that these trees have survived until today. In this place, the average



Fig. 3. Holm oak at Ore.

annual temperature is 12.8° C with an average minimum of -2.3° C. The annual average rainfall is 968.6 mm.

Also found here are magnificent examples of *Quercus pubescens* Willd. The size of these trees is explained by the presence of abundant subsurface water in the form of a subterranean river which lies above a layer of clay. This water layer surfaces in at least two places, and provides them an abundant supply of water at the level of their roots, which proliferate in deep marls rich in mineral elements. These springs empty farther away in a small marsh (Anonymous 1965).



Fig. 4. Holm oak in Alpes Maritimes.



Fig 5. "Big Oak," Alpes, Maritime.

The Haut Conflent (Pyrénées Orientales): The forested massif of Madres-Coronat is between 400 and 2400 m and lies 60 km west of the Mediterranean Sea. This forest features a plant community where *Quercus ilex* is scattered and associated with white oak (*Quercus pubescens* Willd.), junipers (*Juniperus communis* L.; *J. sabina* L.) and *Genista cinerea* DC. These evergreen forests occupy only 3% of the total area of the massif, which is to say about 600 hectares, facing south and east on limestone soils. In another sector of this forest, on soils dominated by limestone or schist, we can observe other old-growth or post-pastoral populations up to 1300m elevation. On the uphill side, these populations are in contact with secondary growth resulting from grazing on moors where Provence broom (*Cytisus purgans* Spach) is dominant. The uses of this forest, both at present and from time immemorial, are for grazing and extraction of forest products.

The climate characteristics are as follows: mean average annual temperature is 10.15° C and average annual rainfall is 780 mm; average of coldest month 0° C and hottest month is 24° C.

Other sites are also possible but more difficult of access; one such is the north slope of Mount Canigou (2784 m); on a site not too far distant from Mount Canigou, Holm oaks occur at 1560m. Expansion of these populations of Holm oak have been particularly perceptible during the recent past.

Mount Aigoual (Gard): This site is an example of a population of *Q. ilex* at its climate limit. In 1939, Aimée Camus published the second of the three volumes of her imposing monograph on the genus *Quercus* composed a year earlier. On page 88, she indicates that *Q. ilex* occurs in a "stunted form on the slopes of Mount Aigoual, between 1100 and 1300 meters, rarely fruiting." In reality, after consultation with different naturalists who possess information, we learn that

these oaks do flower but it is unknown whether they actually reproduce sexually (Fig 6).

These oaks remained somewhat forgotten until several naturalists regained an interest in them well after the Second World War. These individuals, of small size, have indeed been seen in a rather restricted perimeter located near the Arboretum de l'Hort de Dieu, which was established in 1902 by the forester Georges Fabre and the botanist Charles Flahault. The goal of this arboretum was to identify forest species useful for restoring the mountain forest of Aigoual, all but destroyed by decades of heavy exploitation. But no *Q. ilex* were planted in the arboretum, and their presence is therefore not connected to the eventual nonnative plantations. In fact, these oaks can flower, but it is unknown whether they can reproduce sexually (Fig. 7).

The precise location of these trees is somewhat vague. During 2008, after several unsuccessful efforts, we were able ourselves to locate some of these oaks between 1208 and 1219 m. Their GPS specification is as follows: between 44° 11'28" and 44° 11'30" North and 3°58'36" and 3° 58'42" East.

On this site the annual average rainfall is 1947 mm (in 125 days) and the temperatures are as follows: annual average, 6° C, minimal average 3, 02° C, maximal average 6,98° C. Furthermore, it is important to note that the annual average temperature at the summit of Mount Aigoual (where the meteorological station is located) has increased 2° C between 1980 and 1990.

The oaks are found at the edges of steep cliffs which are of difficult access on the southern and southeaster approaches. The rock is schist and the pH here is acid. The slopes belong to the basin of a small river, the Herault. The growth of the oaks is rather slow, and that year, there was no acorn production even if the flowers had been fertile. We do not know if these individuals are capable of



Fig. 6. Holm oak on Mount Aigoual.

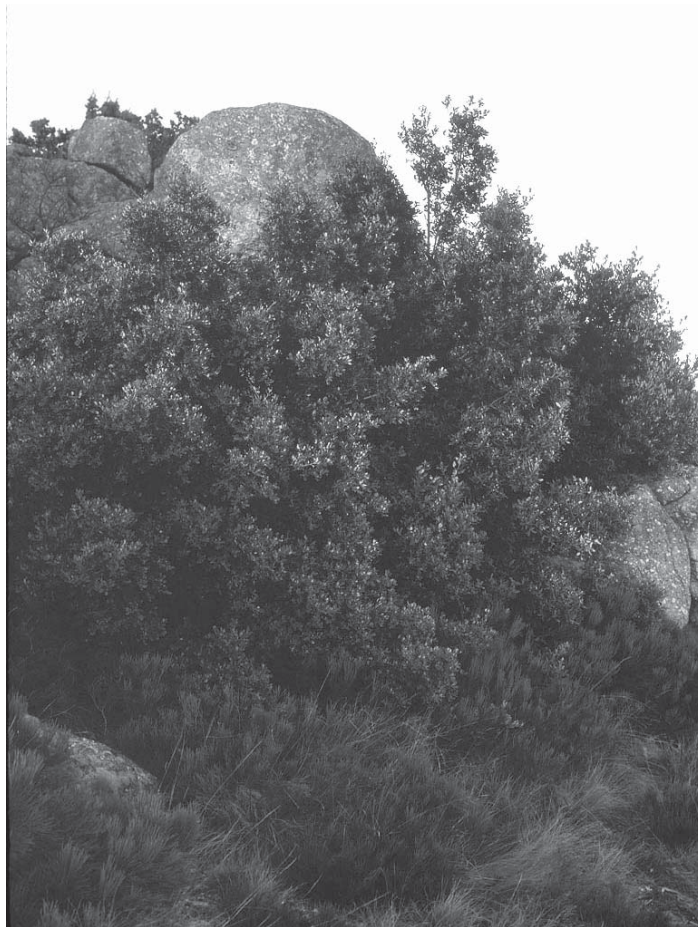


Fig. 7. Holm oak of Mount Aigoual.

producing viable acorns. However, the evident evolution of temperature due to global climate change suggests that opportunities for successful fruiting will be much more frequent in the future than in the past (Fig. 8).

From now on, these trees will be monitored regularly by local botanists and foresters. The largest of the group is about 2.5 meters tall. These specimens are stunted and rather spreading. In view of their dimensions, we think that Aimée Camus must have been referring to other specimens which have since disappeared (landslides, frost?) or else which have not been rediscovered. On the other hand, we know that their presence is to be regarded as the result of dissemination by the oak jay (*Garrulus glandarius* L.) from natural populations on nearby meadows and hills.

These oaks may also originate from acorns from a population identified at 900 meters some 10 km away on rocky granite of acidic pH on a south-facing slope. This latter group consists of rather vigorous shrubs, wider than high and fruiting regularly. They are located to the north of the community of Mandagout on the road which leads to Mount Aigoual passing over Luzette Pass at 1350 m. The mean annual precipitation varies between 1300 and 1500 mm and the lowest mean recorded temperature is -10°C .

The dynamics of this population are vigorous but this phenomenon is relatively recent. In fact, fruiting of these oaks was not observed before the 1980's. Since then, and because of the abandonment of extensive grazing, which has allowed



Fig. 8. Holm oak on Mecliffs of Mount Aigoual.

the growth of seedlings, these oaks are noticeably thriving in the midst of low shrubs of *Cytisus purgans* Spach, the Provence broom (Fig. 9).

This group constitutes at present (and in the absence of contrary information) the highest fruiting population of this region, where the minimal mean temperatures are probably the lowest in winter for this species in France. Moreover, these minima of long duration are much more frequent than at lower altitudes, where they also occur on occasion.

There also exist, on this same road leading to Mount Aigoual, two other isolated individuals growing under pines, a bit above 1000 m. No fruiting was observed,



Fig. 9. Holm oak and Provence broom.

possibly also because of low light resulting from shading.

Naturalized populations of Burgundy: The Holm oak was identified by F. Bugnon in Burgundy in the 1960's in the departments of Cote d'Or as well as in Saone-et-Loire. These trees must be naturalized individuals, because they are located about 260 km to the north of the northernmost populations of *Quercus ilex* in the Mediterranean zone of France, but at about the same latitude as the most northern natural populations on the Atlantic coast. In the Cote d'Or, not far from the wine-producing regions, these oaks have been observed on cliffs and upper limestone slopes in the municipal forest of Chambolle-Musigny and earlier at Gevrey-Chambertin (between 360 and 400 m above sea level with geographical coordinates 47° 13'N and 4° 56' E). In this area, the annual mean temperature is 10.8° C and although oriented toward the South, these cliffs experience low temperatures in winter (-19.5° C) while they reach 40° C in summer. The mean annual precipitation is 754.3 mm.

These oaks have been disseminated by jays from individuals planted in private parks (e.g. in the vicinity of Château and Chassignole and near the Rock of Solutré in the forest of Milly Lamartine) during the course of the 19th and the early 20th centuries. They have enjoyed good conditions for proliferation on these sunny limestone slopes. Nevertheless, the especially harsh winters of 1956 and 1985 (the extreme minimum recorded and cited before is -19.5° C) are probably the reason for the ultimate failure of these spontaneous attempts at wider colonization, the more so because of long periods of deeply frozen ground. This was the case for the rather puny shrubs of the community of Messigny, where at least one individual observed there in 1980 was noted as missing in 2009. However, several shrubs survived these harsh winters and were noted in 1997 and in 2002 on the heights of limestone cliffs at the village of Santenay at the place called "la Montagne des Trois Croix" ("the Mountain of the Three Crosses"). Can this be the beginning of a future colonization? Will the Holm oak be able to naturalize on these limestone cliffs and to increase its range beyond its current natural limit? This situation will certainly bear watching.

Conclusions

In France the Holm oak is under utilized. Its heavy wood is little used except for heating fuel and for charcoal. It could also be used as a fire wall in the Mediterranean region thanks to its wide and dense crown, as could also *Quercus suber* L, the so-called Chêne liège or Cork oak. However, it is mostly as an ornamental, after more than a century of absence, that this tree is slowly becoming of interest among professionals and managers of urban green spaces.

It is possible to suppose that the rise in mean temperature during the last decades, together with a favorable human context (establishment of reserves, cessation of cultivation) would permit the Holm oak, even though dependent on oak jays for its dispersion, to extend beyond its present area of distribution and to become a prominent player in forestation in the next few years.

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