Juniperus phoenicea in Europe: distribution, habitat, usage and threats

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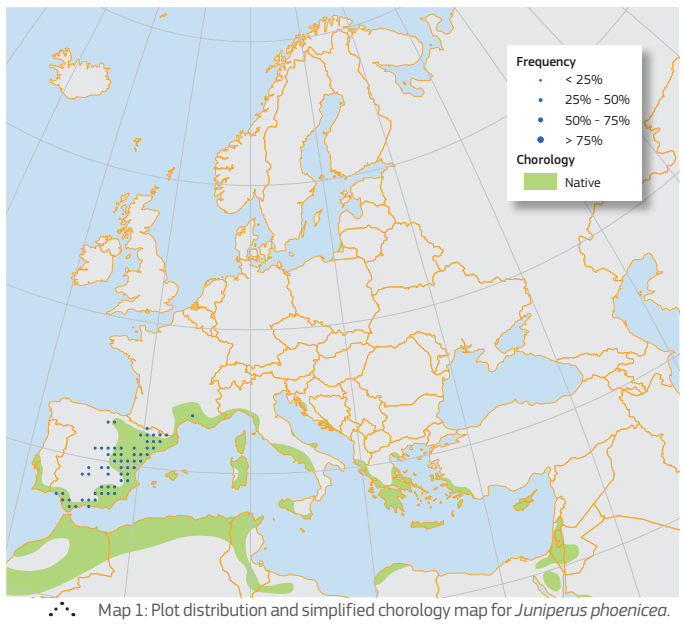
***Juniperus phoenicea* L., commonly known as Phoenician juniper, is a shrub or small evergreen tree, characterised by scaled leaves and berry-like fleshy fruits red to brown in colour. It occurs in patchy and often isolated populations over the whole Mediterranean region, included Morocco and Portugal, Canary and Madeira Islands, Sinai Peninsula and Saudi Arabia along the Red Sea, and grows principally on coastal dunes and cliffs, but also in mountain populations up to 2400 m. With other sclerophyllous species, this juniper forms scrublands and open woodlands belonging to maquis and garigue vegetation. It is adapted to arid Mediterranean climates, rocky and sandy soils, exposed to sea winds and sprays. Its fruits have been used in traditional medicine and cosmetics, and there is now interest in its pharmaceutical properties. The dune habitats where this juniper grows has been shrinking and is still threatened principally by human settlements and but also by artificial plantations of pines or alien species used for dune stabilisation.**

The Phoenician juniper (*Juniperus phoenicea* L.) is a shrub or small evergreen tree which can grow 5-8 m with a trunk up to 1-2 m in diameter[1]. The shrub form develops several stems close to the ground, while its upright form is **monopodial**[2]. The crown is dense, first conical then broadening and irregular in age, with ascending and often curved branches[2, 3]. The bark is dark greyish brown, peeling in narrow strips[3]. On young plants the leaves are needle-like, about 1 mm wide and 5-14 mm long, with 2 stomatal bands above and beneath[4]. On adults leaves are **decussate** scales, alternating in pairs or trios, that are ovate to rhombic, green to blue-green in colour and 1-2 mm long[3, 5]. This juniper is principally **monoecious**, but **dioecious** plants can appear and in some populations be predominant[2, 6]. Male and female cones are single at the tips of branchlets and pollination is driven by the wind. Pollen cones are ovoid, 4-6 mm, while seed cones are spherical to egg-shaped, 8-15 mm maturing after 2 years in a soft, flashy berry-like **galbulus**, about 1 cm across, dark brown to red in colour, which contains 3-9 seeds that are dispersed principally by birds[2, 3, 5, 7]. Two subspecies are recognised according to morphological and ecological differences: *Juniperus phoenicea* subsp. *phoenicea*, which has small obtuse leaves, bigger red-brown seed cones, and sheds pollen in spring; *Juniperus phoenicea* subsp. *turbinata*, which has more elongate leaves, ochre-brown seed cones and shed pollen in autumn[2, 4, 8, 9]. However recent studies on polymeric tannin concentrations[10] and DNA sequences[11] show a significant difference between the subspecies, supporting the recognition of *Juniperus turbinata* as a new species[12].



Map 1: Plot distribution and simplified chorology map for *Juniperus phoenicea*. Frequency of *Juniperus phoenicea* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *J. phoenicea* is derived after several sources[12, 30-33].

Distribution

The distribution of Phoenician juniper covers the whole Mediterranean basin from Portugal on the Atlantic coasts and Atlas Mountains in the West, to Jordan, Sinai Peninsula and Saudi Arabia along the Red Sea in the East, occurring with small and scattered populations. It is also present on Madeira and Canary Islands[1, 2, 4, 13]. It can grow from sea level, up to 2400 m in the Atlas Mountains (Morocco) and in the Asir Range (Saudi Arabia)[1, 13, 14]. The subspecies ranges are still under debate. While some authors describe the *phoenicea* subspecies occurring throughout the whole range and the *turbinata* subspecies only in the western portion on littoral dune habitats[4, 13, 15, 16], differences in phytochemical concentrations suggest that the *phoenicea* subspecies is confined to the eastern Iberian Peninsula and South France and *turbinata* is widespread throughout the whole range[12].

Habitat and Ecology

The Phoenician juniper is a light-demanding pioneer species of meso- and thermo-Mediterranean climates[17], growing in sandy or rocky sites[2] prevalently on calcareous soils but also on silicate[1, 7]. It is a **xerophile** species, adapted to an arid climate with hot and dry summers[2, 7], and can tolerate rainfall of just 200 mm year[1]. This juniper typically belongs to the **garrigue** and **maquis** vegetation and open woodland, forming scrubs and thickets with other **sclerophyllous** species[13]. Phoenician juniper grows principally on coastal zones, but it can also be found in inland cliffs and mountain areas. On coastal stable dunes it develops scrub formations sometimes with prickly juniper (*Juniperus oxycedrus* spp. *macrocarpa*), and other **sclerophyllous** species, such as mastic (*Pistacia lentiscus*), myrtle (*Myrtus communis*), green olive tree (*Phillyrea angustifolia*), rockroses (*Cistus* spp.), etc., forming the vegetation communities belonging to the *Pistacio lentisci-Rhamnetalia alaterni*. It can be associated with coastal pines (*Pinus pinea, Pinus pinaster, Pinus brutia* and *Pinus halepensis*) most often in plantations but also in natural habitats[10, 18, 19]. On cliffs Phoenician juniper forms typical scrubland, thriving on dry, rocky and often **limestone** substrates, characterised by harsh conditions and called **arborescent matorrals**. On coastal cliffs, plants are exposed to the sea spray, sea winds, and severe winter storms followed by drought summers, developing as a short shrub and shaped by the wind. Instead, mountain populations can reach high elevations and are adapted to a more continental climate. Usually they grow on south slopes with other **chasmophytic** species. The associated species of cliff vegetation are very variable, depending on the substratum, geomorphology and in many cases on anthropogenic impacts. Phoenician juniper formations can be the first succession stage of recolonisations (often post-fire), evolving towards the **sclerophyllous** oak woodlands (*Quercus ilex, Quercus suber, Quercus rotundifolia, Quercus coccifera*) in meso-Mediterranean climates, or towards the evergreen **thermophilous** forest (*Olea europaea, Ceratonia siliqua, Pistacia lentiscus*) in thermo-Mediterranean climates[17, 20, 21].

Importance and Usage

This juniper does not does not have significant economic interest[14]. Its wood is rose-coloured, hard, solid and resinous with an aromatic fragrant, fine in grain, appreciated, as other juniper woods, for small manufactured objects and inlay works[22]. In Algeria and Tunisia when the trunk grows straight it is used for joinery and carpentry. In Africa its wood is used mainly as fuel and for the production of charcoal[1, 14]. The reddish fruit cones can be used in cooking and alcoholic beverages[2]. The leaves and the berries have been used in form of infusion, decoctions, tinctures and extracts in various fields and in folk medicine against several diseases[23, 24]. The essential oil was utilised centuries ago in cosmetics and now there is interest in its pharmaceutical properties[25, 26]. Some varieties have been selected for horticultural purposes, planted in rocky gardens[1, 2, 27].

Threats and Diseases

There are no serious pathogens affecting this species[1]. However, the habitats of Phoenician juniper are constantly threatened in coastal zones by the new human settlements and tourism pressure especially during summer periods. The habitat loss and fragmentation over the last years has led to an undoubted decline and isolation of local populations[15, 18]. The cause is not only urban development, but also artificial plantations principally for coastal dune stabilisation, made with pines (*Pinus pinea, Pinus halepensis*, etc.), or exotic species such as black locust (*Robinia pseudacacia*), French tamarisk (*Tamarix gallica*), or desert false indigo (*Amorpha fructicosa*)[18]. Furthermore, the spreading of recently introduced alien plant species, such as American agave (*Agave americana*), tree of heaven (*Ailanthus altissima*) from China, and the **succulent** plants of genus *Carpobrotus* from South Africa, are interfering with native sand dune and cliff vegetation communities dominated by this juniper[18, 28, 29]. Wild fires are another important threat for this species, since its adaptation and resistance to fire is very low, due to its high flammability caused by the presence of aromatic substances, and its poor post-fire re-establishment[18, 20].

Large Phoenician juniper on limestone xeric soil in Milos (Aegean Islands, Greece)

Reddish berry-like fruits (galbulus): these seed cones take 2 years to mature.

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