Abies – Circum-Mediterranean firs in Europe: distribution, habitat, usage and threats

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Most European firs occur predominantly in small to medium-sized populations in the Mediterranean region, sometimes with fragmented and limited distributions, except for silver fir (Abies alba). They all are genetically closely related and can easily hybridise, perhaps as a consequence of late speciation during the late Quaternary. Circum-Mediterranean firs occur principally in mountain areas with medium to high precipitation rates which are mostly concentrated during the winter period. The species are able to tolerate long droughts in summer and tend to form pure stands when in optimal habitats. In the past firs have been extensively logged for construction and firewood and their stands were replaced by other more disturbance adapted species or converted into rural areas. Nowadays with the exception of silver fir and Caucasian fir (Abies nordmanniana), circum-Mediterranean firs do not have a wide commercial interest. In Turkey they are still exploited for timber wood, while other firs have an ornamental use in gardening. Great importance is given to their preservation, especially to those populations which have very limited areas and specimens, with the creation of protected reserves and conservation programmes. Wild fires, livestock grazing and genetic drift represent actually their main threats.

Circum-Mediterranean firs are evergreen conifers from medium (25 m in height for Abies numidica) to large size (up to over 60 m in height for Abies albo and Abies nordmanniana), with columnar trunk and conical crown, which often becomes flattened or rounded in old trees. The stem is straight, composed of short and horizontal branches regularly spaced. The needles are spirally arranged, radially perpendicular and brush-like (Abies nebrodensis, Abies pinsapo var. pinsapo). They twist to point upward (Abies cephalonica, Abies cilicica, Abies nordmanniana) or pectinate in two lateral sets (Abies alba). They are from 1 to 4 cm long, flattened, linear, with two white bands of stomata beneath, round or 1-5 cm long at the apex. Pollen cones are clustered along the undersides of the current year’s twigs, globular or conic, yellow-grey (A. alba, Abies nardoensia, A. cilicica) or reddish purple (A. cephalonica, A. numidica, A. nordmanniana, A. pinsapo). Cones are ovate to cylindrical, resinous, reddish or dark brown at maturity, with rounded scales which present hidden (A. pinsapo, A. numidica, A. cilicica) or protruding bracts (A. alba, A. nordmanniana, A. cephalonica, A. nebrodensis). Seeds are held in a membranous winged cup, brown-reddish, from 5 to 20 mm long. Wood is soft, white to light tan, with little difference between sapwood and heartwood.

Distribution

Today most of these fir species are segregated in small areas as relict and endemic populations, separated by geographical barriers. A. pinsapo var. pinsapo occurs in South Spain in the provinces of Malaga and Granada. A. pinsapo var. marocano grows in the western Rif Mountains in northern Morocco. Abies numidica occupies an area on Mounts Babor and Talahor in the Kabylia region of Algeria. A. cilicica occurs in North Syria, Lebanon and South Turkey. A. nordmanniana has a wider range and is native to West Caucasus and the mountains of North-East Turkey along the Black Sea. A. nordmanniana subsp. equi-trojani forms pure stands on mountains in western Anatolia near to the Aegean Sea. Similarly, A. cephalonica has a widespread distribution; it occurs in the Regions of Espirou, Macedonia, Peloponnese, Sterea Ellas and the Ionian Islands. A. borsii-regis grows in the mountains of the Balkan Peninsula in Bulgaria, northern Greece, the Republic of Macedonia, Albania and Serbia, overlapping the distribution areas of A. alba and A. cephalonica. A. nebrodensis forms only a small population located in the Montagne Mountains in the north-central part of Sicily.

Habitat and Ecology

Except for A. nordmanniana, which can be found also at sea level, generally the circum-Mediterranean firs occur in mountain habitats at altitudes of above 400 m, up to 2 400 m for A. pinsapo var. marocano*. They are located in humid or even very humid climates with an annual precipitation over 700-800 mm, concentrated principally during the winter period**. When well established, mature trees can tolerate long drought periods, but suffer spring frosts. They develop in different parental materials, but grow best on deep soils with high water reserves. Natural regeneration is normally abundant and easy inside their habitat range, but is best below a level of cover which limits the risk of late frost damage and water transpiration losses. Circum-Mediterranean firs commonly form pure stands in their optimal habitat, while at the borders they can be mixed with other tree species, such as beech (Fagus spp.), deciduous and evergreen oaks (Quercus spp.), pines (Pinus spp.), cedars (Cedrus spp.) and junipers (Juniperus spp.).

Importance and Usage

Fir wood is appreciated because it is easy to work with and aesthetically pleasant, due to its soft and light structure. Even if its quality is mediocre compared with other more valuable woods, like spruce (Picea abies), pines and cedars, it has been utilised locally for many purposes. Today A. nordmanniana, A. cilicica and A. borsii-regis, where abundant, are still exploited and the wood is widely utilized in the building sector, for furniture manufacture, veneer and plywood. A. nordmanniana is particularly appreciated for its potential large sized and regular timbers.**-** Thanks to their aptitude to inter-species breeding, some firs have been used for selecting hybrids and cultivars with particular foliage colours, habit and dimensions, and are widely planted as ornamental trees in garden and parks. For example, A. pinsapo is particularly appreciated for their brush-shape twigs, A. nordmanniana is a popular Christmas tree because indoors young plants keep their needles longer and A. numidica is sometimes planted in hedges as it takes pruning well.** Since most of the circum-Mediterranean firs have no wide commercial interest and due to the threats, endemic and geographically scattered distribution, their preservation as genetic resources is a major challenge. Diverse genetic conservation strategies have been elaborated, complementing the protection of natural stands (national or local parks and reserve) with the conservation of genetic resources outside their natural habitats (plantations, orchards and conservation of genetic material in vitro and cryopreservation).** Southern fir populations deserve special concern due to the global warming conditions, particularly in regard to their genetic characteristics, which may be relevant for future adaptation processes of firs.

Threats and Diseases

In the past, deforestation due to logging and forest clearance for agricultural purposes was the main threat, especially for those fir species with a limited distribution area. In Lebanon and Syria fragmented and degraded forests of A. cilicica still suffer from urban pressure with ongoing cutting in marginal rural areas for fuel wood, while A. nordmanniana subsp. equi-trojani stands are more threatened by tourism development.**-** Unlikely others, A. pinsapo has never been extensively felled, probably due to the difficulty of access and the unsuitability for farming of lands occupied by those firs.

Actually, in many countries the most endangered fir forests are regulated by conservation laws and protected in natural reserves, which limit human activities. In those protected areas

Taxonomic notes

Circum-Mediterranean firs have been historically classified on the base of macro-morphological and anatomical differences. However, palaeobotanic, genetic and micro-morphometric studies have recently modified their classification..**-** In fact these firs are closely related genetically and they can easily hybridise naturally and artificially, so that it is not easy to distinguish between them. The speciation probably occurred from a common Tertiary ancestor. Later, firs expanded and contracted following the glacial cycles. Around the Mediterranean basin firs now occupy fragmented and sometimes limited areas. This is largely the result of the geological and climatic history of the Mediterranean region where firs have evolved, having fostered differentiation and local adaptations, which have led to the emergence of many species, subspecies, and varieties.

Actually, the genus Abies is classified in 10 sections, of which two include the circum-Mediterranean fir species. The Abies section comprises fir species distributed in the Centre-North of the Mediterranean Basin. Abies albo Mill. (silver fir), Abies cephalonica Lautouin (Greek fir), Abies x borri-regis Matt. (Bulgarian fir), which is a hybrid of Abies cephalonica and Abies alba, Abies nebrodensis (Lup.) Mattei (Sicilian fir), Abies cilicica Ant. & Kotschy Carrière (Syrian fir), and Abies nordmanniana (Steven) Spach (Turkish fir). Some authors consider this latter as a separate species Abies xequi-trojani as or a hybrid Abies xequi-trojani between Abies cephalonica and Abies nordmanniana. Disjunct fir populations of the subspecies equi-trojani in North-West Turkey, which show minor morphological differences, have led some authors to recognise the subspecies Abies nordmanniana subsp. bornmuelleriana, sometimes considered as separated species Abies bornmuelleriana. The Picasser section comprises firs species distributed in the South-West of the Mediterranean basin. Abies pinsapo var. pinsapo (Spanish fir), Abies pinsapo var. monsorno (Trab.) Cebalos & Bolaño (Moroccan fir) and Abies numidica de Lannoy ex Carrière (Algerian fir) are regulated by conservation laws and protected in natural reserves, which limit human activities. In those protected areas

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*Abies nordmanniana is one of the tallest European trees, growing over 60 m tall. (Copyright weisserstier, www.flickr.com: CC-BY)

**Reddish pollen cones of Spanish Fir (Abies pinsapo var. pinsapo). (Copyright MPF, commons.wikimedia.org: CC-BY)
accidental fires represent the major cause of forest loss. Fires are particularly sensitive to excessive (anthropogenic) fire disturbance, which is pervasive in most Mediterranean areas. When severe, wild fires can destroy entire stands and degrade the habitat, making it less suitable for fires, so that post-fire regeneration is not guaranteed.12, 13, 14. Soil and cattle grazing activity can be particularly destructive when intensive, damaging seedlings and young shoots of juvenile plants and limiting forest regeneration. Now in most forests pasturing continues under control, but in some isolated A. cilicica stands livestock grazing is still one of the main threats.15, 16, 17. Forests degraded by fire and grazing activity are more susceptible to pathogens. A. pinsapo has seen an increase in attacks of the root rot fungus Heterobasidion spp. and the coleopteran Cryphalus numidicus in recent decades, especially in drought periods18, 19, 20.

On the other hand, A. cephalonica needs to be genetically protected, since it is potentially threatened by hybridisation with other fir species, such as A. alba, used in the past for plantations, and their hybrid A. x borisii-regis, which naturally co-exists in the northern part of A. cephalonica distribution. The latter benefits from wetter conditions, therefore A. x borisii-regis ingress may occur influenced by a change toward a warming climate.21, 22

The isolation of populations due to fragmentation might give rise to a low genetic flow and therefore genetic diversity, which may represent another important factor weakening populations and making them more susceptible to diseases. This is the case for A. nebrodensis, which is currently one of the rarest conifer species in the world, counting a population of just 24 mature trees.23 This fir is under an extensive conservation programme locally and abroad for its protection. However, it has not yet been entirely successful, due to the harsh summer conditions and the depleted soil of native areas. New attempts have been planned with the use of compost and summer watering24. 

The total Sicilian fir (Abies nebrodensis) population counts 24 mature trees which are protected by fences. (Copyright Verollanos93, commons.wikimedia.org: PD)