

## Strategies for the conservation and restoration of the relict population of *Abies nebrodensis* (Lojac.) Mattei

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### Abstract

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After a brief account of the taxonomy, ecology and present-day distribution of the native population of *Abies nebrodensis* (Lojac.) Mattei, the authors suggest a protection plan comprising both *in situ* and *ex situ* actions.

### Introduction

*Abies nebrodensis* (Lojac.) Mattei (Fig. 1) is the most celebrated example of endemism in the Madonie mountains. Since it is at present a relict threatened with extinction, it summarizes the complex problems and difficulties involved in the conservation of threatened plants.

Besides its scientific interest *A. nebrodensis* exemplifies the problems of the forest management of the Sicilian mountains. It should also be noted that Sicily has a very high deficit of conifers so that reforestation are undertaken only with exotic species. The only native Sicilian taxon, *Pinus laricio* Poiret, is very little used.

Moreover, *A. nebrodensis* has been differently interpreted from the systematic, phylogenetic and phytogeographical points of view. As far as the taxonomic status and evolution are concerned, in general an infraspecific rank within *A. alba* Miller has been assigned to *A. nebrodensis* from which it would have originated due to the isolation of the Sicilian population during the interglacial periods.

### Taxonomic arrangement

The first botanist who gave a distinct taxonomic status to *A. nebrodensis* was Lojacono-Pojero (1904), regarding it as variety of *A. alba*.



Fig. 1. *Abies nebrodensis* (Lojac.) Mattei.



Fig. 2. Female cone of *A. nebrodensis*.

Later Mattei (1908) raised *A. nebrodensis* to the rank of species. Many other authors agreed with this interpretation except for Nitzelius (1972) who considers *A. nebrodensis* as a subspecies of *A. alba*.

Recent investigations confirm that *A. nebrodensis* differs from the silver fir in some geographical, morphological and ecological features (Raimondo & al. 1990).

From the morphological point of view the differential features are mainly the decussate arrangement of the branches, the typically exerted cone bracts (Fig. 2), the glabrescent young twigs. The leaves are short, keeled, very rigid with a rounded apex. The leaf scar is characteristically different from those of the silver fir, being smaller, circular, with a marked umbo in the centre.

Based on surveys of fossil wood, Biondi & Raimondo (1980) found samples of *A. alba* and *A. nebrodensis* dated about 9200 years BP in some wet places on the Madonie mountains. The palaeobotanical and paleogeographic interest is evident since it testifies the contemporary occurrence of two well distinguished firs on the Madonie mountains having a wider distribution in comparison with the actual one. That is why many researchers think that the relict population of *A. nebrodensis* is hybridogenous.

A contribution to clear up the problem of the *A. nebrodensis* complex came from a recent survey on *A. alba* and *A. nebrodensis* roots in nursery and in field. In particular, macroscopic and microscopic morphological analysis on the mycorrhiza were made in order to identify the symbiont. Preliminary data confirmed that there was a clear difference between silver fir and Madonie fir, even as regards their roots. The ectomycorrhizae of *A. alba* are typically coralloid, dichotomous and enlarged as in all conifers, while those of *A. nebrodensis* have a filiform structure with long and short rootlets (Venturella & Rambelli 1995).

#### **Present-day distribution of the native population of *A. nebrodensis***

According to some historical evidence it seems that *A. nebrodensis* occupied a wide territory in Sicily a few hundred years ago.

Already Gussone (1843), though he did not visit the native population, refers to extensive fir woods on mountains of N. Sicily. Parlatore (1867) on the contrary spoke about a few firs mostly destroyed and sterile.

Other useful but contradictory information came from some students of the Sicilian flora. Morandini (1969) also supposed that *A. nebrodensis* was still frequent on the Madonie mountains in the 17th century. The fir woods would have been destroyed to provide the roof beams of numerous churches in Petralie and Polizzi Generosa towns and for the use by the local population, mainly to obtain firewood.

In addition the effects of grazing, fire and soil degradation on regeneration, led to a severe reduction in the *A. nebrodensis* population.

Subsequent to the situation described by Lojacono-Pojero (1907), further regression of the population leads to doubts about its occurrence in the localities indicated by other researchers.

The native population of *A. nebrodensis* today occupies a very small area of about 100 ha located in the Madonna degli Angeli Valley — between 1400-1650 m, near Polizzi Generosa — on the northern slopes of Monte Scalone and between Monte Cavallo and Monte Pene.



Fig. 3. Area of the native population of *A. nebrodensis* (after Morandini & al. 1991).

According to Morandini & al. (1991) (Fig. 3) it is represented today in nature by 29 plants of different ages; two other plants have resulted from regeneration. This number disagrees with the 32 reported by Mazzola & al. (1993). In particular 24 of them reached sexual maturity and are between 1.50 m and 9 m tall.

#### Ecological summary of *A. nebrodensis*

The situation of the *A. nebrodensis* population agrees with Quézel's review of the ecology of Mediterranean firs (Quézel 1980). In fact the obtuse-needled firs are located in the Mediterranean Basin between 1500 and 1600 m corresponding to the Mediterranean montane zone.

The main climatic parameters are an annual mean temperature of 13°C, 790 mm of rainfall, mostly concentrated in winter, and a dry period of 5 months. Snow precipitation is also frequent together with fog. These data disagree with Quézel's investigations about the climate to which the Mediterranean firs are subjected i.e. an extremely cold and wet climate.



Figs 4-5. Plants of *A. nebrodensis* cultivated respectively in Villa Casale (left) and Villa Lanza (right).

Soils raised on quartzarenite of Miocene origin, are represented by rock outcrop and lithosols (Fierotti 1988).

The actual distribution of *A. nebrodensis* does not allow a clear interpretation of the climatic requirements of the species and its synecological placement. In fact most Madonie firs are located within the Colchic belt which was defined by Pignatti (1978) as a vegetation belt characterized by the predominance of mixed evergreen wood. It is obviously an extrazonal belt which probably has a relict significance. It may be related to the evergreen forests found in Macaronesia, Iberian Peninsula and Caucasus.

The phytocoenosis of *A. nebrodensis* is mainly characterized by the presence of *Fagus sylvatica* L., *Juniperus hemisphaerica* Presl, *Acer campestre* L., *A. monspessulanum* L., *Quercus ilex* L., *Q. petraea* (Mattuschka) Liebl., *Fraxinus ornus* L., *Ilex aquifolium* L., *Malus sylvestris* Miller, *Sorbus aria* (L.) Crantz, *Crataegus laciniata* Ucria and *Cotoneaster nebrodensis* (Guss.) Koch.

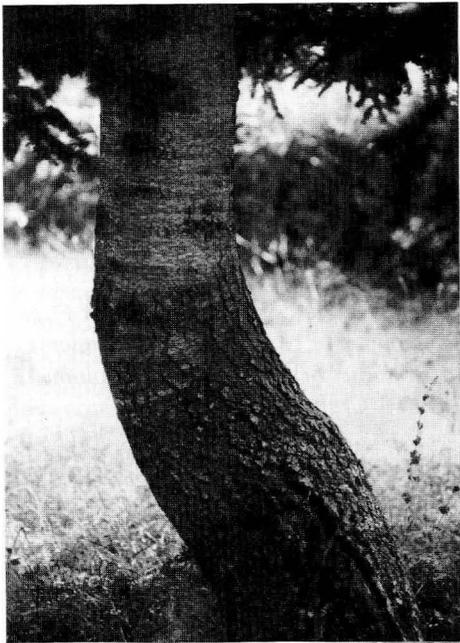
The presence of *Abies nebrodensis* in this type of phytocoenosis of Mediterranean and Tertiary character reinforces the assumption that this species belong to a separate line of descent from *A. alba*.

From an ecological point of view, amongst the Mediterranean conifers the Madonie firs show a remarkable plasticity.

They colonize a series of substrates and adapt to many bioclimatic types and they try to extend their populations (Quézel 1980).



Figs. 6-7. Seedlings of *A. nebrodensis* in the Piano Noce and Piano Zucchi nurseries.



Figs. 8-9. Villa Lanza: graft of *A. nebrodensis* on *A. alba* (left); Piano Noce nursery: individual of Madonie fir obtained by scion (right).



Figs 10-11. Two examples of *A. nebrodensis* cultivated at different altitudes as an ornamental in the Piano Zucchi and Isnello territories respectively within the Madonie Park.

This is shown by the recent increase of natural regeneration within the natural population and by the numerous plants cultivated outside their native area.

One of these, in very bad state of conservation, is found in Villa Casale (Fig. 4), a private residence, in Polizzi Generosa (Palermo) while others in good conditions and bearing fruits are cultivated in Villa Lanza (Fig. 5) near Gibilmanna (Cefalù).

Outside the natural population but not very far away about 113 000 seedlings (Figs. 6, 7) are available at Piano Zucchi and Piano Noce nurseries property of the Regional Forestry Administration (Mazzola & al. 1993). 30 000 of it were located in the last years in many localities of the Madonie mountains.

In the Piano Noce nursery a plant obtained by scion is also present (Fig. 8) while an individual grafted on *A. alba* is present in Villa Lanza (Fig. 9).

In addition an undetermined number of plants is cultivated at different altitudes as an ornamental both within and outside the Madonie area (Figs. 10, 11).

### Protection plan

Considering the good results obtained by private individuals in the cultivation of the Madonie fir it is now possible to suggest a protection plan that, through *in situ* and *ex situ* strategies, allows the use of the many progeny cultivated in nurseries.

The protection plan will be supported by the Regional Forestry Administration and the Madonie Park administration and its efficacy will be strictly linked with the complete

elimination of *A. alba* and *A. cephalonica* in all the Madonie mountains, in the nurseries and in the reforestations.

It provides for the following actions within the Madonie park:

(1) Investigations by scientific laboratories:

- exact synecological and autoecological placement of the species;
- production of mycorrhized plants in order to help sprouting and growth of the seedlings;
- vegetative reproduction in the laboratory with traditional materials and techniques and micropropagation.

(2) Forest management by the Regional Forest Administration:

- expanding seedling production in the Madonna degli Angeli Valley, avoiding the total collection of the female cones and favouring the artificial dispersal of the seeds even at long distance from the ripe individuals;
- increase of the natural population through planting out seedlings of tested genetic purity coming from the Piano Zucchi and Piano Noce nurseries;
- spreading of the species as ornamental plant in all the Madonie mountains in order to stop the use of *A. alba* and *A. cephalonica*. It should be noted that in recent years the use of the Madonie fir as ornamental is already happening. The distribution of the seedlings to the private sector must in any case be appropriately controlled, recording it in a register.

As regards *ex situ* conservation, the following actions should be considered:

- artificial distribution outside Madonna degli Angeli Valley in circumscribed areas;
- planting out seedlings coming from the nurseries outside the Madonie area.

Finally, taking into account that the regeneration within the natural population is very sparse, it is necessary to assure the survival of all the available germplasm.

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