
Zelkova abelicea

During the IDS Crete tour in early May 2018 members heard a lecture on the conservation of this rare Cretan endemic and visited plantation sites where trees are grown, protected from grazing goats. LAURENCE FAZAN and colleagues in Greece, Switzerland and Italy (see end of article) write about the conservation project.

Introduction

The genus *Zelkova* belongs to the elm family (Ulmaceae) and its species were main and widespread components of the forests of the Northern Hemisphere during the Cenozoic Era. Nowadays, the six extant *Zelkova* species have a disjunct distribution. *Zelkova serrata*, *Z. schneideriana* and *Z. sinica* occur in eastern Asia, *Z. carpinifolia* grows in the Caucasus and *Z. sicula* and *Z. abelicea* are endemic to the Mediterranean islands of Sicily and Crete (Kozłowski and Gratzfeld 2013).

Zelkova abelicea (Lam.) Boiss. has a highly fragmented distribution throughout all mountain regions of Crete (Levka Ori, Mt Kedros, Mt Psiloritis, Dikti Mts and Thripti Mts). The species grows between 800 and 1,800 m a.s.l. around karstic sinkholes, on rocky slopes, along gullies and most often in north-facing slopes. Along its upper altitudinal distribution limit, stands are also found on south-facing slopes (Egli 1995, 1997, Søndergaard and Egli 2006, Fazan et al. 2012, Kozłowski et al. 2018).

The species holds a strong patrimonial value: traditional shepherd sticks (katsounes) are preferentially made from its hard, light and durable wood, and big old trees are often found close to abandoned shepherd huts (Rackham and Moody 1996, Fournaraki and Thanos 2006, and personal observations). More than 1 million estimated individuals are distributed in six to ten genetically distinct subpopulations. However, only about 2 to 5% of individuals grow as reproductive fruit-bearing trees. All other individuals cannot produce fruit and exhibit a dwarfed and stunted habit mainly due to overbrowsing by goats (Kozłowski et al. 2014, 2018).

Conservation status and threats

Zelkova abelicea is protected under the Greek law (presidential Decree 67/81) and is included in Appendix I of the Bern Convention (1979), forbidding the collection and use of any of its parts. It is also included in Appendices II and IV of the European Habitats Directive (92/43) and is classified as endangered on the IUCN Red List of Threatened Species (Fournaraki and Thanos 2006, Kozłowski et al. 2012). The main threats to the species are due to caprine and ovine flocks that are responsible for overbrowsing, trampling and habitat deterioration and that impede the survival and growth of seedlings and dwarfed individuals. Dry summer conditions pose an additional threat to seedlings and could be one of



Left. Dwarfed individuals of *Zelkova abelicea* have gnarled and twisted forms due to strong browsing pressure from goats as well as sheep.

Opposite. One of the fenced plots established to protect severely browsed *Zelkova abelicea* individuals. After a few years of protection, the dwarfed trees will have reached sufficient height to escape the goats.

the reasons behind the extremely low proportions of sound fruit produced by some trees. (Kozłowski et al. 2012, 2018, authors' unpublished data). However, *Z. abelicea* produces root suckers abundantly, allowing clonal propagation also in disturbed areas or under suboptimal conditions (Egli 1997, Kozłowski et al. 2018). Due to changes in flock management practices and EU funding policies, browsing pressure has dramatically increased over the last 50 years (Kozłowski et al. 2018). Tree stands are highly fragmented and isolated and some subpopulations are composed solely of non-fruiting dwarfed individuals (Kozłowski et al. 2014, 2018). Fruits are produced in massive amounts every two to three years during masting events (Egli 1997, Søndergaard and Egli 2006). However, *Z. abelicea* produces high quantities of unsound fruit that can reach between 50 to 100% of all fruit produced (Fournaraki and Thanos 2006, Søndergaard and Egli 2006, author's unpublished data). This is problematic in the long term because sexual propagation (fruits) is crucial to maintain an adequate level of genetic diversity. If dispersal is successful only through clonal propagation (root suckering), the species will impoverish genetically.

The conservation project

Since 2014, a conservation project, generously supported by the Fondation Franklinia, is under way to promote and enable the long-term conservation of natural populations of the species by combining *in situ* and *ex situ* conservation actions with communication and outreach activities. The project is carried out on a daily basis by the Mediterranean Agronomic Institute of Chania (CIHEAM-MAICh, Greece) and the four Forest Directorates of Crete (Chania, Rethymno, Iraklio and Lassithi). Scientific support is provided by a panel of international experts from the University of Fribourg (Switzerland), the National Kapodistrian University of Athens (Greece), the Hellenic Agricultural Organization (DEMETER)—Institute of Mediterranean Forest Ecosystems



and Forest Products Technology, (Athens, Greece), and the Institute of Biosciences and BioResources of the Italian National Council of Research (Palermo, Italy).

In situ activities

In situ measures include protecting *Zelkova abelicea* individuals from browsing by fencing selected stands. All forested areas where *Z. abelicea* grows are legally considered as State property and have been so since the Ottoman period. However, shepherds have always had the right to use these areas as pastures

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Zelkova abelicea seedlings cultivated at the Forest Directorate of Chania nursery.

and eventually have considered them as their own. Therefore, land-use conflicts are likely to occur and only small-scaled (25 to 100 m²) fenced areas have been established around *Z. abelicea* stands as they are less prone to deliberate destruction. Currently, 31 areas amounting to a total of 1370 m² have been fenced throughout the distribution range of *Z. abelicea*. The aim is to protect seedlings and dwarfed individuals from overbrowsing to allow their growth, and more generally to allow a regeneration of patches of the local forest ecosystem. *Z. abelicea* individuals reacted strongly and positively to the removal of browsing pressure as soon as the fences were installed. In all fenced areas, previously browsed *Z. abelicea* individuals are growing, albeit at different rates, and some individuals produced new shoots measuring over 1 m in length in a single growing season.



A plantation of *Zelkova abelicea*.

Ex situ activities

Ex situ actions involve collecting fruit for propagation or for storage in seed banks. Fruits are collected every autumn from subpopulations that contain fruiting individuals, with a special effort during masting years. However, fruit collection has been strongly hampered by the fact that most trees outside the Levka Ori (western Crete) have extremely few or no sound fruit and thus seeds do not germinate. Up to now, over 960 seedlings have been successfully propagated at CIHEAM-MAICH and the Forest Directorate of Chania and six seed lots are stored for future uses in the seed bank of the CIHEAM-MAICH. Some of the propagated plants were used to establish a *Zelkova abelicea* plantation or given to municipalities or stakeholders of the areas of origin of the seeds. For subpopulations of *Z. abelicea* without fruiting individuals, or that have trees bearing only unsound fruit, the species is propagated through vegetative root or shoot cuttings. However, up to now, this method has allowed us to obtain only a few viable plants.

A plantation was set up on land given by the Municipality of Platanias in the vicinity of natural stands of *Z. abelicea*. Over 400 plantlets propagated through the project actions were planted in this area that will become a public educational area in collaboration with the Municipality. In the long term, this area will also provide wood to make katsounes (shepherd walking sticks) of certified and legal origin.

Communication and outreach activities

Communication and outreach activities are an integral and important part of the conservation project. Involving the local people in the project is the key towards a successful protection of the species. Information events about the

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One of the biggest *Zelkova abelicea* individuals found on Crete. Trees of this size and age can produce thousands of fruit.



Katsounes or traditional shepherd sticks are made from different types of wood although *Zelkova abelicea* is preferred for its durability and lightness. In these examples, the far left stick is made from *Zelkova abelicea*, the middle one is *Morus* sp. and the right is from the wood of *Olea europaea*.

project activities are organised in villages next to *Z. abelicea* stands to increase local understanding of the project actions and the benefits of investing in a sustainable management of the species and more generally of the forested areas. Innovative ideas, contacts and collaborations have been created through the participation of local communities in these events. Moreover, a website dedicated to the project actions has been created (www.abelitsia.gr) both in Greek and English to promote the project to a wider audience. Other dissemination activities have been organized such as participation in national and international scientific congresses, production of project leaflets, setup of information panels in areas containing *Z. abelicea* that are easily accessible to the wide public and publication of new articles in the local media.

Conclusions

Zelkova abelicea is a long-lived tree and a prominent feature in the Cretan mountain landscape. Both the tree-form and dwarfed individuals act as ecosystems on their own, giving shelter to and harbouring many other living organisms (e.g. insects, birds, mammals, mosses, mushrooms, etc.). Not only are they essential for biodiversity and ecosystem functioning, but they also have a strong cultural value for humans as well.

The conservation of *Z. abelicea* is a complex and challenging task. Many of its easternmost subpopulations are severely threatened with extinction due to the scarcity or the total lack of reproducing tree-form individuals and the increasing probability of unfavorable, extreme climatic events. Nevertheless, not all is lost thanks to the exceptional vegetative resilience of *Z. abelicea* that

allowed the species to cope with browsing pressure for centuries.

From a social standpoint, complexity makes it all the more interesting. Even if the absence of an official cadastre and the attitude of the shepherds has been problematic at times, we are convinced that the efforts made in order to raise public awareness on the importance of *Z. abelicea* will yield important results. The pride of the local villagers turned out to be a key component for the active conservation of the species, switching their attitude towards the project and transforming many of them from indifferent or even suspicious spectators to active tree guardians.

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