ENSC news

The European native seed conservation newsletter

07 *Zelkova abelicea*, the unique endemic tree of Crete and its conservation

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NAME	*Zelkova abelicea* (Lam.) Boiss. Syn: *Abelicea cretica*, *Zelkova cretica*, *Planera abelicea*, *Ulmus abelicea*
DESCRIPTION	Deciduous tree (or shrub) up to 15 m high with a thick trunk and a greyish scaling bark.
LEAVES	Arranged on young shoots, with crenate margins, oblong-ovate, 1-4 cm long, 0.5-2.5 cm wide, with a short petiole up to 3 mm long; the upper surface is usually dark green and sub-lustrous while the lower one is light green and much more hairy.
FLOWERS	Appear in April-May, the fertile hermaphrodite flowers grow singly in the leaf axils near the end of the young twigs and the male flowers appear as stamen clusters just below.
FRUIT	Despite an earlier report of the fruits as nuts (Egli, 1995), the single seeded fruit / oblique, about 5-6 mm in diameter, irregularly and deeply rugose, with bulges and longitudinal farrows; endocarp is pale brown, minutely alveolate (Tutin 1993, Egli 1995, Christensen 1997, Fournaraki & Thanos 2002).
SEED	The embryo is heart-shaped and the embryonic axis is almost completely hidden between the 2 large cotyledons. Endosperm is lacking.
HABITAT	The plant grows on rocky limestone areas, in mountain terrain from about 900 to 1700 m.a.s.l., on north-facing slopes or flat valley bottoms where the soil and hydrological conditions are most favourable. It is relatively widespread in the Lefka Ori and Dikti mountain ranges, with some stands on the Psiloritis, Kedros and Afentis Kavousi Mountains. *Zelkova abelicea* does not form pure stands but it is usually mixed with *Acer sempervirens*, *Cupressus sempervirens* and *Quercus coccifera* trees (Sarlis, 1987).

Why is *Zelkova abelicea* a threatened species?

The plant is usually observed in shrubby form and, only a few, large and regularly-fruiting trees, up to 10-15 m high, are found restricted to a few places, as for example on the slopes near the entrance of the Samaria gorge, on the south end of the Omalos Plateau. Sheep and goats heavily graze its habitats and almost all seedlings and saplings are destroyed. The species is able to carry on vegetatively, by the sprouting of new shoots from the roots of older plants (Egli, 1997). According to Fielding & Turland (2005) 'its existence for the foreseeable future seems assured by the persistence of suckerings, clonal populations which may never produce trees, or in some cases not even seeds, due to routine browsing and periodic cutting'. However, no systematic recording of its populations has been carried out and the total number of adult trees was estimated to about 50-100 individuals (Egli, 1997). In any case, there is an urgent need for the reassessment of the conservation status of *Zelkova abelicea* according to the new World Conservation Union criteria (IUCN 2001). Its timber is durable and local people use the branches as raw material for making the traditional hooked walking sticks ('katsouna' in the local dialect). Despite the inclusion of *Zelkova abelicea* in the collection and trade ban by the Greek Law (Presidential Decree 67/81), a flourishing business of *Zelkova* walking sticks has developed in the last decades, mainly driven by increased demand. The price of a single walking stick in the tourist shops of the city of Chania and elsewhere in Crete ranges between 30 and 50 euros and may sometimes reach up to 120 euros for 'high-quality' ones. As a consequence, their production has considerably increased and many trees have been 'pruned' by a number of skilled shepherds, familiar with the technique of making these traditional walking sticks. As they say, the wood of *Zelkova* is very hard and resistant and the walking sticks made of it may maintain a 'working life' of at least a century, much greater than those made of wood from mulberry *(Morus alba)*, Kermes oak *(Quercus coccifera)* and olive *(Olea europaea)*. Woodcutting and wildfires should be also mentioned as potential threats albeit of minor importance.

***In situ* conservation**

Despite the fact that numerous scientists have recognized the preservation of *Zelkova abelicea* in Crete as urgent (e.g., Sarlis, 1987; Egli, 1997; Fielding & Turland, 2005), the natural populations of the species are still threatened.

The legal protection of the species and its status as a vulnerable species in the Red Data Book of Greece and the Red List of IUCN do not seem to offer much protection.

The authorities responsible for the *in situ* conservation and protection of *Zelkova* are the various Forest

Legal protection

Zelkova abelicea is listed as vulnerable in the Red Data Book of Greece (Egli 1995) and by IUCN (1997, as included in the database of the World Conservation Monitoring Centre, Walter & Gillett, 1998). It is protected by a Greek national law (Presidential Decree 67/81): the collection and export of any plant material of *Zelkova* is prohibited unless with a special permit issued by the Ministry of Rural Development and Food. It is additionally protected by the Bern Convention (1979, rev. 1992) and by the EU, Annexes II & IV of the Habitats Directive.

Directorates of the Region of Crete while the Forest Directorate of Chania is in charge of the largest stands in the island. About ten years ago they tried to fence some areas in the massif of Lefka Ori in collaboration with the local municipalities. Regrettably, their efforts were not successful due to conflicts between landowners on one side and shepherds on the other.

Fortunately however, last August (2005) the Forest Directorate of Chania confiscated a sizable number of traditional sticks made of 'ambelitsia' from the tourist shops of Chania and brought to justice both makers and tradesmen. They also published an article in the local newspapers and informed the public about the important status of the species and the illegality of making walking sticks from 'ambelitsia'. On the other hand and in regard to grazing, none of *Zelkova* habitats is presently protected by fencing or other means, and the plant is still overgrazed.

Ex situ conservation

The Seed Bank of MAICh was established in 2000 and its purpose is to enhance the *ex situ* conservation of the endemic and threatened plants of Crete (ca 200 taxa) by storing and preserving a representative range of their genetic diversity.

These species are usually threatened by various human interventions and changes of land use. One of the first accessions to enter the seed bank of MAICh was actually a seedlot of *Zelkova abelicea* collected in November 2000 from one of the largest natural populations of the species, at the Omalos Plateau (1200 m.a.s.l.). Information concerning *Zelkova* seed storage behaviour and germinability gathered prior to collecting were quite discouraging. On the one hand, another species of the genus *(Z. serrata)* is recorded in the Compendium of Seed Storage Behaviour (Hong et al., 1998) as probably a recalcitrant species.

Germination and growth of the seeds of *Zelkova abelicea* was studied at the Institute of Systematic Botany at the University of Zurich. About 10% of the seeds germinated in 1985 and in 1991 out of 50 000 seeds only about 20 seeds germinated (germination conditions not described, Egli, 1997). In the nursery of the Forestry service at Chania they obtained a similarly very low percentage of final germination in their efforts to propagate *Zelkova* from seeds.

We are now able to report the following:

A. Seed storage behaviour

Fortunately, the seeds of *Z. abelicea* have been proven to be 'orthodox' (Fournaraki unpublished). They survived in storage both for two years in the MAICh drying room (15°C, 15% RH) and subsequently for 4 months in hermetically closed containers at -20°C, which means that seeds of *Z. abelicea* can be safely conserved under seed bank conditions.

B. Seed collection and cleaning. Fig. 1

The dispersal units of *Z. abelicea* are short annual shoots with dry leaves still attached, which fall off together with a few fruits (Fournaraki & Thanos, 2002). Dispersal takes place at the end of October and during November, which is the appropriate season for seed collection .

According to Egli (1997) the species seems to have a three-year-cycle of high fruit production and from the appearance of the seedlings, the author suggested that 1985, 1988 and 1991 were 'productive years'. Surprisingly enough, our observations do confirm this strange 'three-year-cycle' of relatively 'successful' (but never particularly 'high' so far) fruit production. When we first collected fruits in 2000 (9 years after Egli's last observation) we found out that ca 50% of them were 'empty' but in 2001 only a 3.5% fraction of the seedlot was 'sound'. Similar low results were found in 2002 but 2003 was again a 'successful' year for fruit production with 40% 'sound' seeds. Obviously, more research is needed to validate this reproductive cycle of the plant and, more importantly, to elucidate the factor(s) responsible. The weight of the seeds can be used in the assessment of the quality of the seedlot in general and of the soundness of each individual seed in particular. Curves of seed weight plotted for a number of individually weighed seeds are bi-sigmoid - the first and second sigmoid 'parts' corresponding to empty and filled seeds, respectively. Empty fruits usually weigh, after drying, less than 10 mg and the mean seed weight of sound seeds (solid circles) is 15.22 ± 0.21 mg . As a consequence of the knowledge gained we can currently separate 'sound', heavier seeds from 'empty' ones by using a seed blower (Agriculex), a much easier and considerably less time-consuming job, particularly during an 'unsuccessful' year.

C. Laboratory germination. Fig. 2

Numerous germination experiments of *Z. abelicea* seeds have been performed in the laboratory (Fournaraki, unpublished). Seeds are sown on agar gel (2%) and incubated in 4 growth chambers set at constant temperature (5, 10, 15 and 20°C) under a daily photoperiod (12/12 h light/dark). For germination experiments in the dark, dishes with seeds are incubated within lightproof, metal containers in the same cabinets, and seeds are routinely inspected in a dark room under a dim, green safelight. Germination of seeds takes place only at low temperatures, 5 and 10°C. The germination rate is remarkably low: germination is manifested 40 days after the onset of imbibition and is completed after a total period of 4 months (at 10°C L/D, the optimal conditions for germination) (Fournaraki & Thanos, 2002; Fournaraki, unpublished).

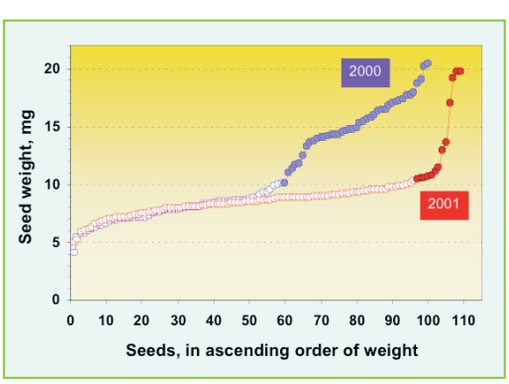

Fig. 1 Individual seed weights of *Zelkova abelicea* collected in 2000 and 2001 from the Omalos Plateau (Lefka Ori). Open and solid circles represent empty and sound seeds, respectively (Fournaraki, unpublished).

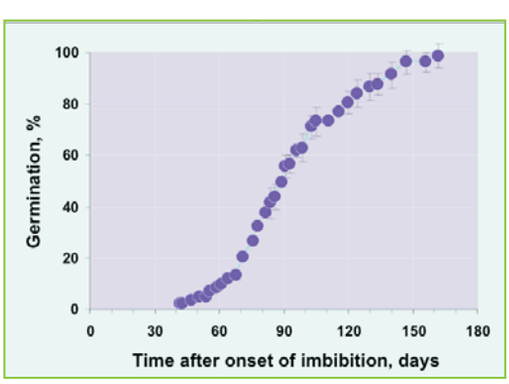

Fig. 2 Germination time course of *Zelkova abelicea*. Seeds incubated at 10°C (Light/Dark, 12/12 h) (Fournaraki, unpublished)

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PRACTICAL NURSERY PROTOCOL FOR GERMINATING *ZELKOVA ABELICEA* SEEDS (IN CRETE)

SELECT SOUND SEEDS
(WITH A COLUMN BLOWER OR BY INDIVIDUAL WEIGHING).

↓

IN DECEMBER SOW "SOUND" SEEDS IN WET SAND OR SOIL

↓

PLACE THE CONTAINER WITH SEEDS AT 5°C
(IN A DOMESTIC REFRIGERATOR)

↓

4 MONTHS LATER TRANSFER THE CONTAINER
IN A WARM AND SUNNY PLACE

↓

WITHIN 1 MONTH SEEDLINGS WILL HAVE EMERGED

Finally, our four-year-long experience of cultivation in the nursery and the Botanical Garden of MAICh has shown that seedlings and saplings of *Zelkova abelicea* grow quite well and have proven to be hardy against disease. Currently, most of the seedlings produced by the Seed Bank of MAICh are donated to the nursery of the Forest Directorate of Chania.

A dispersal unit of *Zelkova abelicea*

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