

**Global Survey of**  
*Ex situ Zelkova Collections*



**Botanic Gardens Conservation International**

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Many botanic gardens around the world have freely contributed data to the survey (Annex 2), and their contributions are gratefully acknowledged. BGCi would also like to acknowledge the assistance of the following organisations in the promotion of the survey and the collection of data: American Public Gardens Association, Chinese Academy of Science (CAS) Botanic Gardens Committee, European Botanic Gardens Consortium.

Cover image: *Zelkova abelicea* (Dr. Gregor Kozlowski)

## Summary

*Zelkova* is small genus that comprises six tree species in the northern hemisphere with a disjunct distribution.

Botanic Gardens Conservation International (BGCI) and the Botanic Garden of the University of Fribourg in Switzerland have come together to jointly develop a global action plan for the conservation of threatened *Zelkova* species. This survey forms the first phase of this project, the results of which will go to inform the genetic analysis in the next phase.

The survey identified that all of the *Zelkova* taxa are currently held in living collections by botanic gardens and arboreta. In total 255 *Zelkova* records<sup>1</sup>, from 137 institutions in 27 countries were identified. Of the 255 records included in the analysis, just 17 records of the most threatened *Zelkova* taxa (*Z. sicula* and *Z. abelicea*) were identified.

The report concludes by a series of recommendations based on the results of the survey including: up to date conservation assessments, the strengthening of existing *ex situ* collections, establishing new collections, carrying out genetic analysis of collections of wild populations, implementing restoration and reintroduction activities, involving local communities and organisation in conservation activities and developing public awareness programmes.

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<sup>1</sup> For the purposes of this survey, a record/collection is the presence of a single living *Zelkova* taxon within an institution and may include multiple accessions and/or individuals.

## Introduction

*Zelkova* (Ulmaceae) is a small genus that comprises six tree species in the northern hemisphere. It is an interesting genus with a disjunct distribution: three species in eastern Asia, one species in western Asia and two species in the Mediterranean.

The most endangered species in the genus is *Zelkova sicula*, discovered only recently in Sicily. The known number of individuals does not exceed a few hundred (rarely larger than 2 meters in height) and covers a very small area of



Figure 1. Global distribution of *Zelkova* (Dr. Gregor Kozlowski)

the southeastern part of the island. *Zelkova sicula* is currently listed as Critically Endangered according to IUCN's Red List Categories and Criteria, and is the only *Zelkova* to have recently been assessed.

Another Mediterranean island endemic, *Zelkova abelicea*, is restricted to Crete (Greece). Its conservation status is Vulnerable (VU), but this assessment needs to be updated as it was carried out over ten years ago and against a former version of IUCN's Red List Categories and Criteria. More recent field expeditions and investigations have discovered several new populations; however it is proposed to keep the Vulnerable status due to expanding road constructions, intensive grazing and other anthropogenic activities.

The third *Zelkova* which has been assessed against IUCN's Red List Categories and Criteria is *Z. carpinifolia*. However, like *Z. abelicea*, its assessment (Near Threatened) was carried out over ten years ago and against a former version of the Categories and Criteria and therefore needs to be re-assessed. *Z. abelicea* distribution includes a number of countries in western Asia (Turkey, Georgia, Armenia, Azerbaijan and Iran), however it is thought to be threatened in a number of places.

The three East Asian *Zelkova* species have much larger distributions and have not been assessed against the IUCN's Red List Categories and Criteria, however this should not be interpreted as they are not under threat. As for *Z. carpinifolia* and *Z. abelicea*, these three East Asian taxa need their conservation status to be re-assessed or assessed for the first time.

Based on the current assessments, attention is required to ensure that both *Z. sicula* and *Z. abelicea*, the 2 taxa considered to be at most risk of extinction (Critically Endangered and Vulnerable), are conserved. It is clearly important that these taxa are represented in well-managed *ex situ* collections as an insurance policy for the future and in support of Target 8 of the *Global Strategy for Plant Conservation* (GSPC).

**Global Strategy for Plant Conservation, Target 8:**

*60% of threatened plant species in accessible ex situ collections, preferably in the country of origin, and 10% of them included in recovery and restoration programmes*

At the same time habitat protection and restoration should be reviewed and mechanisms put in place for local people to be involved in and benefit from the *in situ* conservation and management of these globally important trees.

## Methods

An international survey of *ex situ* collections of *Zelkova*, building on information held within BGCI's *PlantSearch* Database, was undertaken by BGCI. The results of the survey have enabled us to identify precisely which species are currently held in *ex situ* collections. From this information, the gaps and the opportunities have been identified in order to develop a prioritised plan for the long term integrated conservation of the *Zelkova*.

All BGCI's institutional members were invited to participate in the survey; however participation in the survey was not limited to BGCI members. Awareness of and invitations to participate in the survey was promoted through BGCI's website ([www.bgci.org](http://www.bgci.org)), a number of mailing lists and a range of networks, organisations and events including: American Public Gardens Association (APGA), Chinese Academy of Science (CAS) Botanic Gardens Committee, European Botanic Garden Consortium.

The survey of *ex situ* collections was carried out through a range of methods, including:

- Analysis of data held in BGCI's *PlantSearch* database ([www.bgci.org/plant\\_search.php](http://www.bgci.org/plant_search.php))
- Through direct contact with botanic gardens and networks holding *Zelkova* collections
- Data collected from online databases of living collections:
  - The multisite BG-BASE search facility maintained by Royal Botanic Garden Edinburgh ([rbg-web2.rbge.org.uk/multisite/multisite3.php](http://rbg-web2.rbge.org.uk/multisite/multisite3.php))
  - Database of Asian Plants in Cultivation maintained by Quarryhill Botanical Garden and California Academy of Sciences ([research.calacademy.org/research/botany/quarryhill/index.asp](http://research.calacademy.org/research/botany/quarryhill/index.asp))

In addition to the presence or absence of a *Zelkova* from a collection, the following closed questions were also asked:

- Is this *Zelkova* from a known wild source or from horticultural/unknown origin?
  - horticultural or unknown source
  - of known wild provenance
- What is the approximate size of the collection?
  - 1 individual
  - 2 to 10 individuals
  - 11 to 30 individuals
  - 31 to 50 individuals
  - more than 51 individuals
- Is this *Zelkova* collection part of a restoration or reintroduction programme?
  - no
  - Reclamation
  - Rehabilitation
  - Ecosystem restoration
  - Translocation
  - Re-inforcement/Supplementation
  - Conservation/Benign Introduction

The resulting submissions were cross-checked with the accepted names with synonyms of *Zelkova*.

Although efforts were made to limit their impact on the final results, the survey has inherent limitations which mean that it can never be considered to be truly exhaustive and final. Surveys, such as this one, can be limited by issues correct identification of specimens, the degree of participation by collection holders in the survey and the dynamic nature of *ex situ* collections which evolve and change over time. Also, important additional specimens may be held in private collections which are not covered by this survey.

## Results

### General findings

The survey identified that all of the *Zelkova* taxa are currently held in living collections by botanic gardens and arboreta. In total 255 *Zelkova* records<sup>1</sup>, from 137 institutions in 27 countries were identified. Of the 255 records included in the analysis, just 17 records of the most threatened *Zelkova* taxa (*Z. sicula* and *Z. abelicea*) were identified. This is not unsurprising since these two *Zelkova* species are the two with the most restricted natural distribution; both are small island endemics. The *Zelkova* with the widest natural distribution, *Z. serrata*, is also the most common *Zelkova* in botanic garden collections.

Figure 2. Botanic gardens with known *Zelkova* collections.

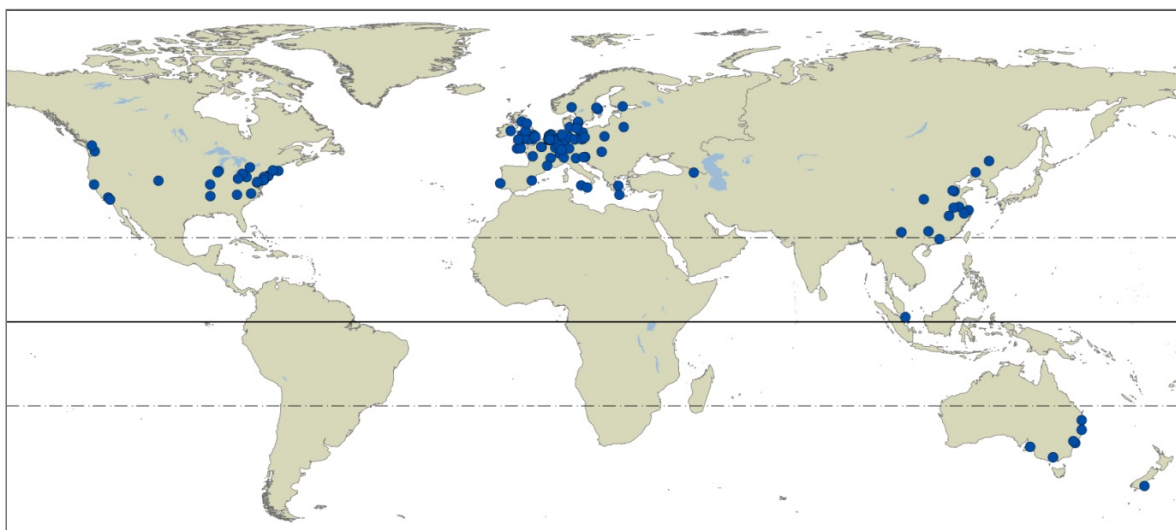


Table 1. Summary results

	RDL Category	Number of Collections
<i>Z. abelicea</i>	VU	14
<i>Z. carpinifolia</i>	LR/nt	57
<i>Z. schneideriana</i>	NE	44
<i>Z. serrata</i>	NE	106
<i>Z. sicula</i>	CR	3
<i>Z. sinica</i>	NE	31

<sup>1</sup> For the purposes of this survey, a record/collection is the presence of a single living *Zelkova* taxon within an institution and may include multiple accessions and/or individuals.

## Collections in the country of origin

Target 8 of the GSPC calls for *ex situ* collections to be held where possible in the country of origin. All of the *Zelkova* taxa are found to limited degrees in countries of their origin.

*Z. abelicea* (VU) 2 collections

*Z. serrata* (NE) 12 collections

*Z. carpinifolia* (LR/nt) 1 collection

*Z. sicula* (CR) 1 collection

*Z. schneideriana* (NE) 10 collections

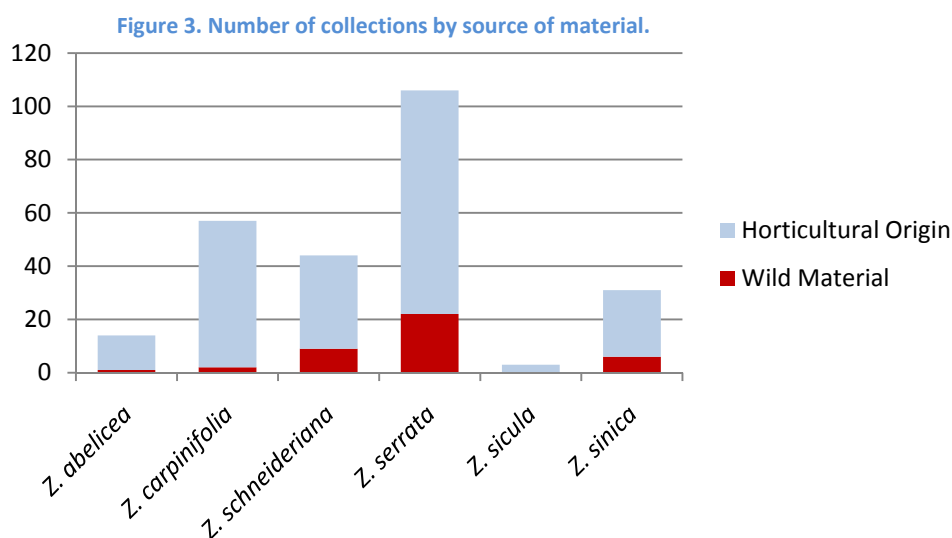
*Z. sinica* (NE) 3 collections

## Ex situ collections representativeness

The survey attempted to gauge how representative the *ex situ* collections are by requesting information on the size of the collection and whether the collection is derived from known wild sources or not.

Table 2. Number of collections by source of material.

	RDL Category	Wild sourced material	Unknown or horticultural origin
<i>Z. abelicea</i>	VU	1	13
<i>Z. carpinifolia</i>	LR/nt	2	55
<i>Z. schneideriana</i>	NE	9	35
<i>Z. serrata</i>	NE	22	84
<i>Z. sicula</i>	CR	0	3
<i>Z. sinica</i>	NE	6	25



However, relatively little information about the source of the material and the size of the collections was submitted (See Table 2) and it is difficult to draw conclusions about how representative the known *ex situ* collections are and their value to restoration and recovery action. Even if the collections are based on wild collected material, it does not guarantee that the associated documentation linking the collections to their sources exists or is at a level which supports their value to future restoration and reintroduction activities.

*Zelkova sicula* is so rare in the wild and in horticulture that the collections identified in this survey are almost certainly based on wild collected material since there are no known other sources.

## Recommendations and the way forward

This survey forms an important step in the development of a global plan for the conservation of *Zelkova* taxa. Whilst all the known *Zelkova* taxa are known to horticulture and are currently in botanic gardens, relatively few collections are known to be based on wild sourced material and relatively few are known in the countries of their natural distribution. Therefore, in order to support the long term conservation of *Zelkova* a number of priorities and actions can be identified. With the most restricted natural distributions, the Mediterranean and Western Asia *Zelkova* species should be the priority taxa if it is not possible to include all 6 species.

With this in mind the report recommends the following actions:

- ***The current conservation status of all Zelkova taxa should be assessed against the IUCN Red List Categories and Criteria.*** With the exception of *Z. sicula*, all *Zelkova* species need to be reassessed or assessed for the first time. The assessments should include the development of detailed distribution maps for each species.
- ***Strengthen and develop existing ex situ collections to ensure that they are representative, accessible and safe.*** It is important that all *Zelkova* species are held in at least 2 secure *ex situ* collections that are representative of the natural diversity of the taxa and located whenever possible in the country of origin. This should involve the genetic analysis of *ex situ* collections and the comparison of this diversity with the natural diversity of wild populations.
- ***Develop and implement restoration and reintroduction activities for the most threatened taxa.*** The taxa which are under risk of extinction should be the focus of concerted conservation efforts to strengthen and conserve the remaining wild populations by appropriate methods.
- ***Involve local communities and organisations in conservation activities.*** As with all successful conservation activities, the involvement of the local communities and organisations is critical to the long term conservation of threatened species, and should be encouraged and supported from the earliest stages of planning conservation activities.
- ***Develop public awareness and understanding programmes in regions where Zelkova species are at most threat.*** To support current conservation efforts and develop new opportunities, public awareness and understanding programmes need to be developed and implemented as an integral component of conservation activities. This includes both areas where *Zelkova* species naturally occur and are utilised, as well as regions where they are of horticultural interest.

The Botanic Garden of the University of Fribourg, Switzerland, will take forward the development of the *Zelkova* action plan through the next phase. The University of Fribourg, in association with partners around the world, aims to carry out genetic analysis of *ex situ* collections and wild populations. They will focus on the three most restricted *Zelkova* species but where possible will also include the other species in the analysis. Whilst collecting genetic material for analysis, the University of Fribourg will gather more in depth information on the existing collections and wild populations in support a detailed action plan to ensure the long term conservation of *Zelkova*. During this period, potential pilot sites, projects and conservation partners will also be identified.



## Annex 1 *Zelkova* taxonomy

Extant species of *Zelkova* (accepted names with the most commonly used synonyms in parentheses)

Species:	Distribution:
<b><i>Z. sicula</i> Di Pasquale, Garfi &amp; Quezel</b>	Sicily (Italy)
<b><i>Z. abelicea</i> (Lam.) Boiss.</b> ( <i>Z. cretica</i> Spach.)	Crete (Greece)
<b><i>Z. carpinifolia</i> (Pall.) K. Koch</b> ( <i>Z. ulmoides</i> Schneid.) ( <i>Z. crenata</i> Spach.) ( <i>Z. hyrcana</i> Grossh. & Jarm.)	Turkey, Georgia, Armenia, Azerbaijan, Iran  [perhaps a separate species from the Hyrcanian region in Iran/Azerbaijan]
<b><i>Z. sinica</i> C. K. Schneider</b>	China
<b><i>Z. schneideriana</i> Hand.-Mazz.</b> ( <i>Z. schneiderana</i> )	China
<b><i>Z. serrata</i> (Thunb.) Makino</b> ( <i>Z. formosana</i> Hayata) ( <i>Z. keaki</i> Maxim.) ( <i>Z. acuminata</i> Planch.) ( <i>Z. hirta</i> C. K. Schneider) ( <i>Z. tarokoensis</i> Hayata) ( <i>Z. japonica</i> Dippel.)	Japan, Korea, Kuril Islands (Russia), Taiwan, China

## Annex 2 Participating institutions

The following 137 institutions from 27 countries are gratefully thanked for their contribution of data to this report:

Arboretum Bokrijk, Belgium; Arboretum Freiburg-Guenterstal im Staedtischen Forstamt Freiburg, Germany; Arboretum Groenendaal,, Belgium; Arboretum Kalmthout, Belgium; Arboretum of the Barnes Foundation, United States of America; Arboretum Oudenbosch, Netherlands; Arboretum Volcji potok, Slovenia; Bergius Botanic Garden, Sweden; Botanic Gardens of Adelaide, Australia; Botanic Gardens Trust, Sydney, Australia; Botanical Garden Faculty of Science, Croatia; Botanical Garden of Delft University of Technology, Netherlands; Botanical Garden of Vilnius University, Lithuania; Botanical Garden, Natural History Museum - University of Oslo, Norway; Botanische Gärten der Universität Bonn, Germany; Botanischer Garten der J.W. 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