

Part C: The Plant Collection – Linchpin of the Botanic Garden

Chapter 7: Using the Plant Collection – Research, Conservation, Public Engagement, Recreation and Tourism



• Population introduction

Contrary to reintroduction, introduction is the intentional movement and establishment of an individual or a group of individuals outside their natural range (IUCN, 2013). The aim is to prevent extinction of populations of the target species by establishing new ones in suitable habitats with favourable environmental conditions in areas where they have not been recorded from in recent geological history. Population introduction may be required as climate change and global warming and/or other change agents threaten the survival of a population or the entire species in their present habitat.

A critical aspect of an intended population introduction is to undertake a rigorous risk assessment as regards the potential of the species becoming invasive in its new location. Many introduced species may not demonstrate clear signs of

invasiveness only until several decades later following their establishment. Thus, introduced target species should continue to be monitored in the long run (Smith *et al.*, 2013). Equally, a risk assessment should evaluate the danger posed by any pests and pathogens that the introduced plant material might be carrying, as well as the probability of hybridisation between related species. Botanic gardens in particular are well-aware of the potential threats posed by newly accessioned plant material for their existing collections as well as for wild plant populations (Chapter 3, Section 3.4.4 and Chapter 6, Section 6.8). This technical knowledge and practical knowhow coupled with the wide range of areas of expertise in plant identification, sampling, propagation and cultivation, make botanic gardens also vital stakeholders of all stages of introduction in the wild, from planning to provision of plant material over to actual introduction work and monitoring (Case study 7.1.16).

CASE STUDY 7.1.16

Securing the future of a unique Sicilian plant on the verge of extinction – population introduction of *Zelkova sicula*

Giuseppe Garfi and Salvatore Pasta, Palermo, Italy; Stéphane Buord, Brest, France; Gregor Kozłowski and Laurence Fazan, Fribourg, Switzerland; Joachim Gratzfeld, Richmond, United Kingdom

Discovered in 1991, only two small populations of the relict plant *Zelkova sicula* are known, located on the slopes of the Iblei Mts. in south-eastern Sicily (Italy). The species faces an uncertain future and has been included in the IUCN Red List of Threatened Species as Critically Endangered. Both populations are restricted to the bottom of small gullies with rivulets. Although *Z. sicula* appears to be partially

adapted to the Mediterranean climate (suggested for instance by the sclerophyllous leaf traits), recurrent dieback triggered by summer-drought indicates that the populations are located in an area with suboptimal environmental conditions. Sexual reproduction in the wild has not been recorded to date, although a few dozens of plants in each population perform uneven flowering and fructification. Fertile fruits have not been found probably due to the triploidy of all individuals in both populations. The species proliferates however vegetatively, via root suckering or basal resprouting following disturbance or injury. Due to their clonal identity, the two populations have a very low adaptive potential. In addition, they are confined to the present enclaves situated within the thermo-Mediterranean belt, whilst a swift adaptation to rapidly changing, drier and warmer environmental conditions seems impossible. Population introduction may therefore represent the most effective conservation strategy, if not the last resort, to secure the survival of *Z. sicula*.

→→→



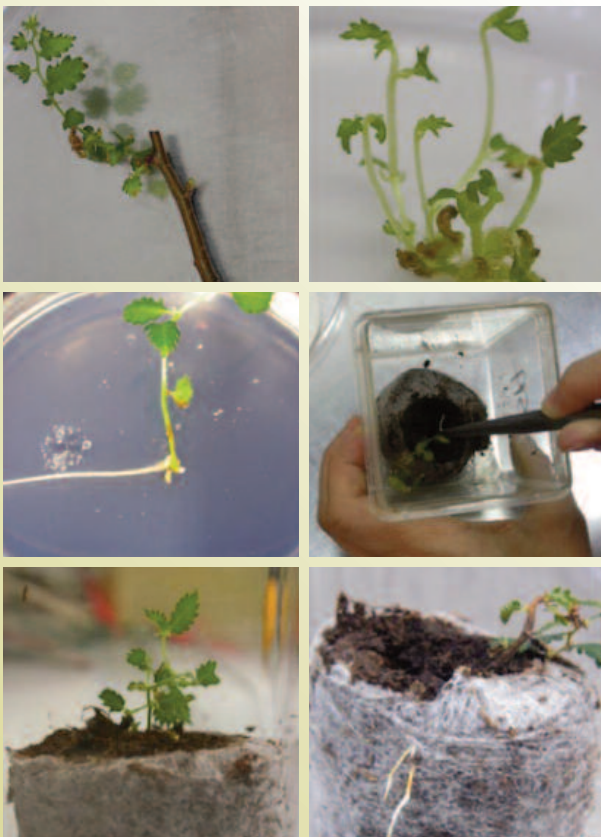
Zelkova sicula wild population (Contrada Ciranna) – habitat and habit. (Images: left: Giuseppe Garfi; right: Joachim Gratzfeld)

CASE STUDY 7.1.16 (CONT.)

Planning for long-term conservation – plant material collection and development of propagation protocols

Recognising the urgency of rapid intervention, the Institute of Biosciences and Bioresources, Unit of Palermo (IBBR-CNR), Italy, the Conservatoire Botanique National of Brest (CBNB), France, as well as the Botanic Garden of the University of Fribourg (BGF), Switzerland, joined hands to devise a conservation programme for *Z. sicula* aiming at population introduction to new habitats. Two fundamental actions preceded this endeavour: i) evaluation of the genetic diversity within the species to capture the highest genetic adaptive potential; and ii) collection of plant material and development of propagation protocols.

The molecular analyses revealed a clear difference between the two populations but identical genetic profiles within each population, confirming two different clonal lineages. To reflect occasional genetic changes arising from mutations, collection in both populations targeted material from as many mother plants as possible. Capitalising on their longstanding experience in germplasm conservation, seed germination and propagation of endangered plants, CBNB and IBBR-CNR developed vegetative propagation protocols using cuttings and *in vitro* techniques. Supported by the European Commission LIFE project 'Zelkov@azione' and BGF, propagation protocols are continuously refined, and the stock of plants is steadily growing.



In vitro propagation and explant stages of *Z. sicula*. (Images: Angela Carra)

Initial population introduction trials

The next step consisted in the selection of suitable sites for introduction of new populations. Data gathered on significant growth performance of a few individuals raised in *ex situ* collections suggested more humid sites in the meso- and supra-Mediterranean belt as suitable new habitats, characterized by mixed forests with summer-green, broadleaved deciduous trees. These plant communities are similar to those where the other extant West-Eurasian *Zelkova* species thrive, and match the species composition of communities with *Zelkova* spp. based on palaeoecological data. A further key requirement included the proximity to small streams as observed in the current habitat.

Three out of 17 initially identified sites were evaluated as providing the best habitat suitability and adequate site accessibility (i.e. Bosco Tassita, Nebrodi Mts.; Bosco Pomieri, Madonie Mts.; Bosco Ficuzza, Sicani Mts.). Two supplementary plots were chosen in the thermo-Mediterranean belt at Bosco Pisano, near one of the extant populations. To ensure long-term conservation and sustainability, only public land and locations within the Natura 2000 network or other protected areas were selected. However, as all sites are within protected areas, a longwinded administrative procedure was necessary to obtain permission from the managing authorities to introduce the plant into the local forests. A thorough risk assessment of the potential impact (such as invasiveness and introduction of pests) was undertaken, followed by the establishment of a detailed monitoring plan. Prior to outplanting, all saplings were transferred for acclimatization to a forestry nursery located in an area with meso-Mediterranean climate conditions, and regularly checked for eventual pests and diseases. In four of the five sites fences have been established to prevent browsing disturbance by wild and domestic ungulates.

→→→



Wild populations of *Zelkova sicula* (green dots):

A: Bosco Pisano, B: Contrada Ciranna, Iblei Mts.

Introduction sites (red dots):

1: Bosco Pisano; 2: Bosco Tassita, Nebrodi Mts.;

3: Bosco Pomieri, Madonie Mts.; 4: Bosco Ficuzza, Sicani Mts.

CASE STUDY 7.1.16 (CONT.)

**Letting nature take its course – yet under controlled conditions**

First planting trials were carried out in June 2016 in the pilot sites of Bosco Ficuzza and Bosco Tassita using 15 plantlets per plot. They were introduced in the forest understorey at irregular intervals, prioritising streamside locations and half-shade conditions. Additional measures were taken, such as the use of hydrogel (a high water retention polyacrylate, able to prolong water supply) as well as covering the planting holes with a biodegradable mulch mat to reduce evaporation. Watering was provided right away and an irrigation plan was established for the first growing season to respond swiftly to potential drought. Planting activities continued during winter 2016 in these and two new sites (Bosco Pomieri and Bosco Pisano), raising the total number of saplings planted to over a 100 (on average some 25 per site). These efforts will be further consolidated over the coming years, including additional planting in all sites.

A truly novel approach to save a unique plant from the brink of extinction, this population introduction experiment complements ongoing efforts to secure *Z. sicula* in botanic gardens and other institutions working for plant conservation (Kozłowski and Gratzfeld, 2013). If the introduced individuals successfully establish over the coming years to form new populations, this endeavour will serve as a practical illustration of using horticultural excellence and *ex situ* conservation as an insurance policy in a future marked by rapid climate change and altering ecosystems.



Introduction of Zelkova sicula (Ulmaceae) to a new habitat, Bosco Ficuzza, Sicily. (Images: Giuseppe Garfi)

As many ecosystems and habitats are transforming into new, non-historical configurations owing to a variety of unprecedented local and global transformations including climate change, novel combinations of species are emerging that have not occurred before. Management of such 'novel ecosystems' (Hobbs *et al.*, 2009) as of targeted population introductions that also represent

new species assemblages, is one of the great conservation challenges in the twenty first century. Botanic gardens which are steadily embracing and promoting an integrated *in* and *ex situ* conservation approach, are once more at the forefront to guide, support and implement innovative strategies aimed at securing plant diversity for future generations.