Wild service tree

Sorbus torminalis

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These Technical Guidelines are intended to assist those who cherish the valuable wild service tree genepool and its inheritance, through conserving valuable seed sources or use in practical forestry. The focus is on conserving the genetic diversity of the species at the European scale. The recommendations provided in this module should be regarded as a commonly agreed basis to be complemented and further developed in local, national or regional conditions. The Guidelines are based on the available knowledge of the species and on widely accepted methods for the conservation of forest genetic resources.

Biology and ecology

Wild service tree (*Sorbus torminalis* L. (Crantz)) is a diploid species (2*n*=34) belonging to the family Rosaceae. It can hybridize with at least two other species of *Sorbus*: whitebeam (*Sorbus aria*) and mountain ash (*Sorbus aucuparia*). Hybridization with whitebeam commonly occurs, especially where the natural ranges of these species overlap. Most of these hybrids are triploid (3*n*=51) and a few (mainly *Sorbus latifolia*) are tetraploid (4*n*=78). Hybrids reproduce mainly by apomixes.

Wild service tree is a fast-growing tree, reaching maximum height at around 80–100 years, when they are typically 20–25 m in height with trunks of 50–70 cm diameter. Exceptional trees can reach up to 30 m in height and 1 m diameter at 200 years old.

Wild service tree produces hermaphrodite flowers visited by a wide range of generalist pollinators (social bees, bumblebees and beetles). Flowering and seed production can start in trees <10 cm diameter under optimal conditions. The fleshy fruits are dispersed by birds, especially thrushes, and by mammals (foxes, martens). Seed dormancy is usually one winter long. Alternation of warm and cold temperatures has been reported to increase the rate of germination in laboratory conditions.

Wild service tree favours deep fertile soils, but can tolerate a wide range of soil conditions, from chalky, superficial, dry soils to temporarily waterlogged soils. It can adapt to a variety of climatic conditions, but occurs most often in lowlands.

Wild service tree is a light-demanding species, often outcompeted by other hardwood species, in particular beech. When overtopped by other trees, wild service tree rapidly weakens and wastes away, but even a small opening in the canopy is enough to allow its development. It is described as a nomad, post-pioneer species often found growing as a minor component of oak and beech woodland. It can easily colonize forest clearings and low-density forest stands, notably thanks to efficient seed dispersers.

Vegetative propagation by root suckers can occur, and may increase the tree's competitive abilities. This is the major way to colonize disturbed areas and to survive the competition from other species.

Distribution

Wild service tree is widely distributed across Europe, from the northern extremity of Africa to the south of Sweden and from the east of Great Britain to the north of Iran. It usually occurs at low density throughout its range (0.1–30 individuals/ha).

Importance and use

Wild service tree is favoured by hunters, because its fruits are well appreciated by many bird species and a few mammals. The fruits are also used to produce liquors, especially in Germany and Austria.

Wood of the wild service tree is fine-grained, very dense and has good bending strength. It was used in the past to make screws for winepresses, billiard queue sticks, musical instruments and turnery. Today, it is usually only used for decorative veneers. Wild service tree is one of the most valuable hardwoods in Europe. In the 1990's, wild service tree has been the highest priced timber species in Europe.

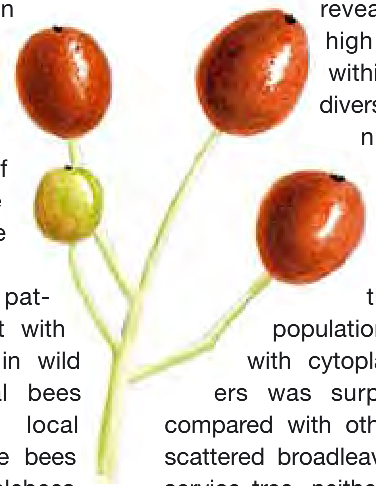
Genetic knowledge

Investigations of the population genetics of wild service tree have begun only recently. To date, the available results are based on surveys with neutral genetic markers. These surveys highlighted some important genetic processes that shape the level and organization of genetic diversity in the wild service tree.

Hybridization with other species of the *Sorbus* genus occurs predominantly as wild service tree (father) to whitebeam (mother). It is rarely followed by cytoplasmic introgression. As a consequence, interspecific geneflow should not significantly affect the diversity dynamics within wild service tree.

Wild service tree is a predominantly outcrossing tree. The rate of self-fertilization is estimated at <1% in open-pollinated progenies, and is very variable across mother trees. This very low rate of self-fertilization supports the hypothesis of a partial self-incompatibility system as in *Sorbus aucuparia*.

Patterns of pollen exchanges in wild service tree show two main trends: preferential mating between neighbouring trees due to local pollen dispersal, combined with long-distance dispersal (up to 2.5-km dispersal events have been documented). This results in a low pollination effective size: on average, only six effective pollen donors contribute to the pollen cloud of a given mother tree. But at the same time, a proportion of the pollen donors are far away from the mother tree.



These mating patterns are consistent with pollination ecology in wild service tree: social bees intensively exploit local resources, but some bees and especially bumblebees are also able to fly long distances to find new nectar resources.

Similar trends have been observed for ongoing patterns of seed dispersal. Most seeds are dispersed in the close neighbourhood; 174 m on average between an established seedling and its mother tree. But at least 17% of the seedlings collected in the middle of a 470-ha forest stand originated from outside of that stand.

These patterns of pollen and seed dispersal result in strong levels of spatial genetic structure at a local scale. Wild service trees were observed to be distributed in aggregates of 150-300 m in radius, corresponding to individuals more genetically related than expected by chance. These aggregates are likely to correspond to successful colonization of favourable sites by sibling trees.

In contrast, genetic surveys at regional and larger scales revealed rather high levels of within-population diversity, for both nuclear and cytoplasmic markers. The level of differentiation between populations observed with cytoplasmic markers was surprisingly low compared with other European scattered broadleaves. For wild service tree, neither pollen- nor seed-mediated geneflow effect was predominant (genes are propagated on average at equal distance by seed and pollen).

Patterns of genetic diversity on a large scale thus indicate that, even though pollen and seed are predominantly dispersed a short distance in wild service tree as in most plant species, rare events of long-distance pollen and seed dispersal deeply affect the long-term dynamics of genetic diversity in this species. This may be a general trend in species combining good dispersal abilities and colonizing dynamics.

Chloroplast DNA studies on a European scale revealed a weak phylogeographic structure. Differences in haplotype frequencies observed between the western and eastern parts of Europe could indicate the presence of different refuges in Europe during the last glaciations. On a regional scale, no phylogeographic structure was found. Intensive seed movement since postglacial recolonization could have blurred a pre-existing phylogeographic structure.

Genetic structure shows little evidence of the impact of human management on wild service tree dynamics. Within management units, a mixing of progenies of local mature trees and distant mature trees from neighbouring management units has been found. Thus, regeneration within management units must account for the presence of seed trees all over the forest.

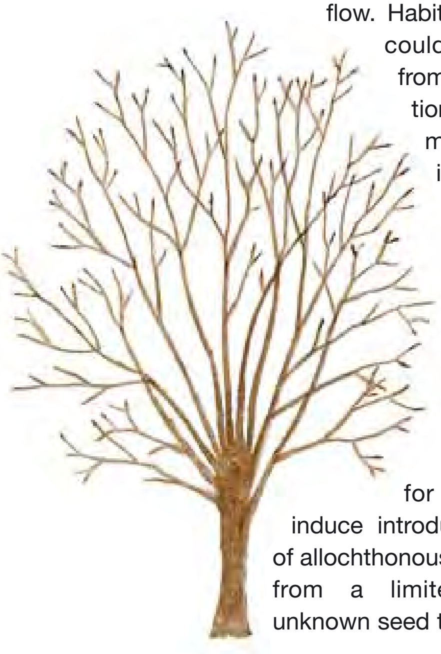
Threats to genetic diversity

Wild service tree is a scattered tree and its genetic diversity can be considered at risk in certain conditions.

Wild service tree is sensitive to competition. Therefore there may be a risk in dense regular high forests which contain a high proportion of long-lived species. The high level of interspecific competition could impede the regeneration process and lead to local extinction. Thus the species may be in great danger if no new sites are available for colonization and establishment.

As for all forest trees, habitat fragmentation could induce a strong decrease of genetic diversity through reduction of population size and ruptures of geneflow. Habitat fragmentation could result either from forest destruction or by management not oriented in favour of wild service tree. This species is particularly threatened by habitat fragmentation due to its low population density.

The demand for wood could induce introduction in forests of allochthonous seeds collected from a limited number of unknown seed trees.



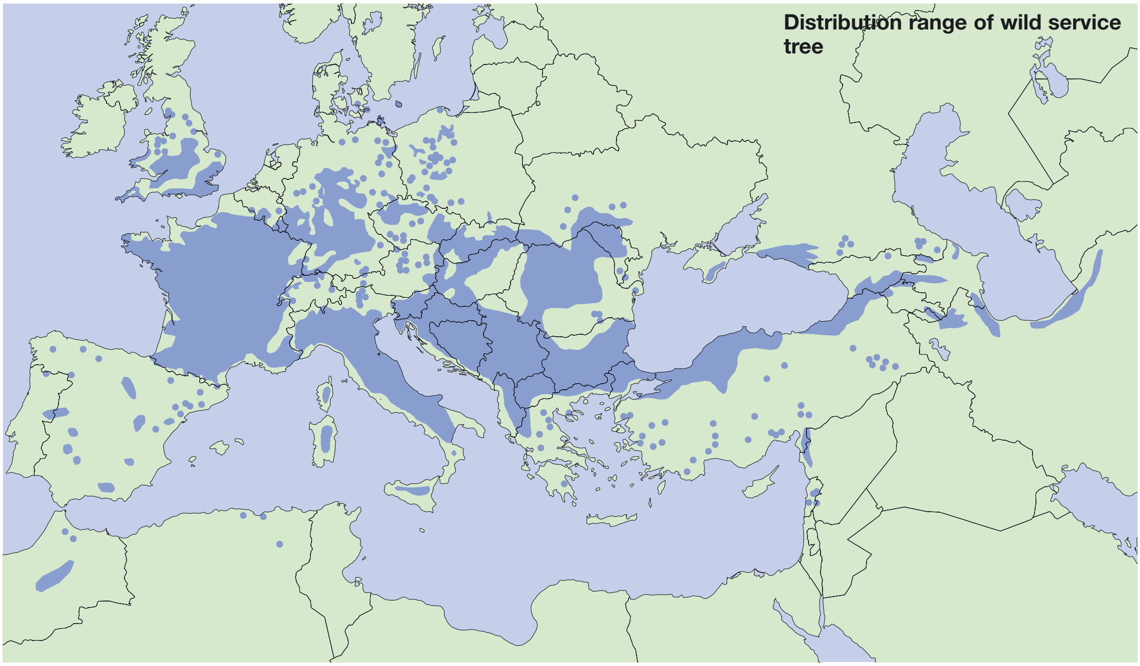
Guidelines for genetic conservation and use

***In situ* measures**

Dynamic conservation maintains the diversity of evolving populations thanks to the combined effects of environmental pressure and sexual reproduction. *In situ* conservation is applied through a network of conservation units (natural stands).

For species with extinction-recolonization dynamics, it is not possible to define units of conservation. Indeed, the extinction-colonization events and high levels of seed flow could not be maintained in conservation units. Here, the issue is not to limit the large geneflow but rather to conserve it. It is also necessary to maintain the entire ecosystem dynamic because wild service tree dynamics are closely related to forest succession. Therefore, wild service tree conservation should not be practised at the local level (several hectares) but at the landscape level or even at the regional scale. For now, it is not possible to indicate a critical population size below which the populations would be threatened.

Conservation efforts need first to be focused on common forestry practices. For long-term sustainability of wild service tree genetic resources, forest management must be oriented in favour of each single tree. First, competition from neighbouring trees must be controlled and wild service trees need to be released



at each logging intervention. Second, the forester must be aware that the seed trees of the neighbouring compartments will also contribute to regeneration. Most importantly, regeneration of wild service tree must be established before that of social broadleaves. In this way, the young wild service tree seedlings are given a competitive advantage against oaks or beeches. It is also important to ensure a regular distribution of wild service tree even with small clusters or single individuals. The local disappearance of some trees is not harmful to the population because seed flows allow colonization at long distances. But the forester must ensure the presence of a favourable site for new establishments. On the regional scale, an effort must be also made to favour the presence of wild service tree. The regional dynamics of geneflow are very important to conserve the local dynamic geneflow.

Ex situ measures

When it is not possible to apply *in situ* conservation, or measures for seed supply, *ex situ* conservation must be considered. To establish artificial conservation populations, the seeds must be collected from many trees with a distance of more than 200 m between them, to enlarge the genetic basis and to avoid relatedness. Planting conditions (site, planting distances, care and tending over the first years) must be carefully controlled. The core collections could be created regionally so that the seed could be used to reinforce some small populations. If the core collection is not isolated from other wild service trees (>10 km), geneflow can not be excluded. The strategy could be combined with ecological engineering techniques used in environmental restoration projects.

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EUFORGEN

These Technical Guidelines were produced by members of the EUFORGEN Noble Hardwoods Network. The objective of the Network is to identify minimum genetic conservation requirements in the long term in Europe, in order to reduce the overall conservation cost and to improve the quality of standards in each country.

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The distribution map was compiled by members of the EUFORGEN Noble Hardwoods Network based on an earlier map published by Kutzelnigg, H. in 1995 (*Sorbus torminalis*. In: Scholz, H. (Hrsg.), 1995: Gustav Hegi. Illustrierte Flora von Mitteleuropa. Band IV, Teil 2B (2. Aufl.). Blackwell, Berlin.

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