The Service Tree

The Tree for a New Europe





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The Service Tree – the Tree for a New Europe

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The largest service tree of Bohemia and Moravia, called "Adamec's service tree" on the Žerotín hill near Strážnice with the estimated age of 470 years (1, 2012).

Fruit trees are immensely useful – apart from bearing fruit they make the land more fertile and healthy. They give different kinds of beautiful wood... Alleys protect fields from being dried by wind... and meadows from being barren from snow cover that is good for the harvest.

Planting and tending fruit trees take away the opportunities for idleness and wickedness stemming from it – drinking, lewdness, stealing... In a sense it is a great means of cultivating and improving the human spirit and heart.

František Pixa, 1848

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Foreword

Just a few years ago, for me the service tree was one of the few indigenous fruit trees whose importance had been declining. With the co-author of this publication – Zdeněk Špíšek, who asked me to supervise his dissertation work dedicated to this interesting tree, I have discovered the value of this unique tree. The nutritional composition and delicate taste of sorb apples can make them an important dietary supplement. Legends about the medicinal effects of service trees in folk medicine handed down for centuries have now been explained by the presence of active substances and indirectly by their utilisation in alternative medicine. The tree itself is a phenomenon. Not only does it provide highly acclaimed wood, but it is also an important landscape feature of south-eastern Moravia that constitutes a substantial part of the local landscape character.

The basic aim of this book is to introduce the service tree and its significance from different perspectives. The target audience of this publication is the general public, which is why it is quite practical. Advice on planting and processing of fruit and wood guides us as the Ariadne's thread. We read about the context of service-tree planting in history and see it as an object of scientific research, for instance in the area of genetics or biotechnology. Examples of regional oral traditions revealing the importance of this species for our ancestors, are interesting as well. However, the main benefit is the number of practical advice on how to grow and take care of service trees, how to harvest their fruit and prepare traditional products from them.

I wish this publication helped the readers to discover the importance of this valuable tree, same as the authors helped me to discover the "mysterious service-tree universe". The book makes me want to plant yet another service tree. I believe that it makes the readers feel the same, thus helping to reintroduce service trees to south-eastern Moravia, and not only there.

Dr. Radim J. Vašut
Department of Botany
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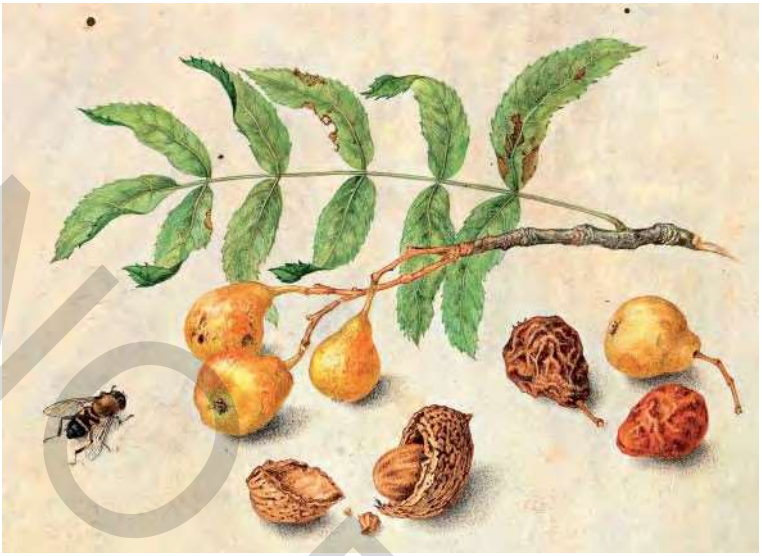
Olomouc, 4 April 2014



A still-life in the manneristic rendering by painter Giovanna Garzoni from the year 1640, depicting probably the old service-tree variety Panocchiane that grows in southern Italy.

Foreword

Dear readers,
old trees have been disappearing all across Europe recently, especially the fruit ones. The old is being replaced with new, modern and exciting. The importance of old species and varieties of fruit have often been forgotten, and therefore it needs to be reminded to avoid the disappearance of their unique characteristics and beauty. Old fruit trees have been neglected in our region and sometimes even systematically destroyed. Their fruit is considered a rather unpleasant waste. Trees in rural landscapes – often their regional varieties – are important not only for pomology, but they also play an important role as border points, anti-erosion features, landmarks in the landscape and as family trees that link the lives of individuals and families with the landscape. Old trees create also a unique habitat for many other organisms and they are valuable biological and ecological landscape elements.
Nevertheless, there are still areas in our country where people have kept their natural relationship with trees and nature. One such example is the Moravian Slovakia region near the Czech-Slovak border. Thanks to its continuous agricultural tradition, old varieties of apples, pears, plums and rarer species, such as mulberry, medlar, quince, dogwood and service tree have been preserved in local landscape. And for its uniqueness, the service tree has become a symbolic tree of the Moravian Slovakia region and is experiencing its renaissance.
This book draws on the publication "Service Tree from A to Z" (Hrdoušek et al., 2003) and its aim is to acquaint the public with this unique European tree – the service tree (*Sorbus domestica*).
The aim of this publication is to raise awareness of this nearly forgotten fruit tree and to make its landscaping, culinary, forestry and medical benefits available to the future generations of Europeans.

Vít František Hrdoušek, 2014

To my father, who planted many trees.

About the service tree

Eveline Moinet, 2009 France
For centuries, the *cormier* tree has been a source of food, medicine and wood. The things that haven't been forgotten have been passed down orally, but even this is being forgotten. The remaining trees constitute a valuable biological and cultural heritage. Our task now is to ensure the conservation of the service tree in our rural landscapes and to give it an honourable place in the context of today's agriculture.

Cristina Bignami, 2000, Italy
Up until now, the presence of the *sorbo* trees at the foot of Vesuvius has been almost ignored. Neither is the service tree part of the national inventory of fruit trees genetic resources in Campania. Despite the efforts of the general public to restore the use of traditional fruit, the prospects of preserving service trees on the slopes of Vesuvius, as well as in the rest of Italy, are very small. The aging of the trees as well as the farmers who grow them is the reason why the possibility of their use is extinguishing. Another threat is the expansion of urban areas that gradually take up agricultural land in the countryside.

Brütsch et Rotach, 1993, Switzerland
There are many good reasons to protect "*Speierling*". In addition to its value for the nature there are landscape/ecological and cultural/historical motives together with traditional economic interests that can save this tree species.

Miletić et Paunović, 2012, Croatia
"*Skoruša*" has the most modest demands of all fruit trees. It is resistant to a number of pests and it has a high nutritional value. This fruit gives valuable raw material for the production of food even in drier and rockier peripheral areas.

Charles Etienne, 1577, France
The first fruit wine in Europe was probably made from sorb apples. It is the only wild tree that produces large quantities of edible fruit that can be dried for storage.

Wedig Kausch, 2000, Germany
In Western Europe, especially in France and Germany, when a solitary service tree is felled together with wild service trees, pear and apple trees, they are all

included in the same group of "*Schweizer Birnbaum – Swiss pear*". An 1868 Saxon Forestry School textbook provides information on the price of service-tree timber at that time: "A service-tree trunk with the diameter of 40 cm and the length of 4 m was sold at the price of 12 gold ducats." Today, the price of quality service tree timber even higher: for instance, in Germany, 1 m3 of service tree timber cost 1500 euro in the year 2000.

Thomas Kirisits, 2008, Austria
The symbol of the year 2008 in Austria was the "*Aschitzenbaum*" the rarest tree in the country, whose numbers have been declining for more than 100 years all over Central Europe. This happens due to reckless forestry management and the insensitivity of people towards trees in the landscape.

Zdeněk Špišek, 2013, Czech Republic
The service trees in Moravian-Slovakian border grow into the largest trees within their native territory. The research of the past 10 years has shown that the number of service trees declines and a number of giant service trees in the open countryside are in a poor condition. There is no natural species recovery and there has been no regeneration in the past 60 years. This was caused by changes in landscape management: land consolidation into large fields and monocultural forestry management. The overpopulation of herbivores, especially hoofed game, has had a considerable influence as well. On the other hand, a number of new activities have cropped up, such as service tree planting into vineyards, along the roads and in baulks. Events such as "The Service Tree Festival" are being organized that acquaints the general public with the value of the tree. I believe that this publication will contribute to an increased interest in the service tree in Europe.

The motif of a service tree is interesting even for decorative and applied arts (B. Krška, 2011)

Service tree branch in the "Grandes Heures d'Anne de Bretagne" illuminated by Jean Bourdichon from France; dated 1503– 1508 (4, 2009).

II. 1. Service tree in historical sources

Ancient Greece and Rome

The first direct written record concerning service tree fruit comes from ancient Greece: Theophrastos (371–287 B.C.) described the fruit in detail, also providing a precise description of the service-tree leaves. The Greek term for the tree is "Oia" – οὖα, ὠϊά, ὠά, οὖα, ὴ and the fruit – ὄον. A translation (Kausch, 2000) of Theophrastos would go something like this: "The service trees are of two sexes: female, which bears fruit, and male, fruitless. We also discern them by fruit: they range from round to egg-shaped ones. The fruit can be further differentiated by taste: the round ones are quite fragrant and sweet, the pear-shaped are often a little fragrant and sour." There are many details in his description, for instance that in the autumn the leaves fall in one piece. In another chapter, Theophrastos describes the grafting of fruit trees.

Wood engraving of a service-tree from the 16th century from Aldrovandi's extensive collection of products of nature in Bologna, Italy (repro-photo 3, 2000).

Other ancient writers focused on the use of the fruits and other parts in medicine and gastronomy (Kausch, 2000). In ancient Greece and Rome there are records of the production of must and wine from service tree fruit mixed with pears, quinces or medlars. The term "sorbum" can be found in the work "De Agri Cultura" (200 BC) by Roman censor Marcus Porcius Cato (234–149 BC), a form of which – *Sorbum* – has been preserved as a name for the service tree and even gave the name to a whole genus of rowans (Paganová, 2003). In his book "Agricultural Topics in Three Books", Marcus Terentius Varro (116–27 BC) categorises service tree fruit, together with quinces and medlars, as apples and describes their preservation by the sun-drying of cut-up fruit, which is then kept in a cool, dry place. In the Georgics, in the chapter on orcharding, Vergil (70–19 BC) mentions the production of sorb-apple wine by the Scythians in south-east Europe.

In The Natural History (Naturalis historia, 77 CE) by Pliny the Elder (23–79 CE) describes three types of service tree and discerns them from the wild service (*Sorbus torminalis*). He mentions a way of "cutting" the real painting vermillion with goat blood or sorb-apple juice (Ajasson, 1833). Pliny the Younger (61–113 CE) describes the preservation of service tree fruit in a large clay pot insulated by plaster and buried two feet under the ground in a sunny place (Kausch, 2000). Described is also the drying of the fruit in a stream of fresh air. Greeks and Romans disseminated pomology throughout Europe; they planted not only vine, but also service trees (Rotach, 2003). Described was also the propagation by seeds and cuttings: "twigs separated from the trees live but have to have fibres from their mother's body" (Tetera, 2006). In "De Materia Medica" Dioskorides (1st century CE) writes that service-tree fruits can be used for the treatment of intestine disorders – diarrhoea – and that ground fruit can be used instead of barley flour. Dioskorides' work became the cornerstone of traditional medicine and botany for the following 1500 years.

Service tree growing from the ruins of the Roman town of Pompeii (1, 2007).

In his work "De re rustica", known also as "Opus agriculturae", Palladius (4th century CE) is the first to have dealt with the aspects of orcharding. He writes: *"Large trees can be grown from the pips of large service-tree fruit – they grow strong and yield good fruit. The tree prefers cool places with enough water, and very fertile ground in the mountains. Reddish worms are often found in its wood."* Palladius also describes the use of the fruits for the production of wine and vinegar. He also mentions the primitive stratification and the possibility of grafting on hawthorn and medlar rootstocks. He even adds advice for farmers on how to achieve greater yield: by damaging the trunk and roots (Kausch, 2000). He also describes replanting; he recommends replanting seedlings with large rootballs (Hrdoušek et al., 2003). The book "De Re Coquinaria" (around 115 CE), called also "Apicius" after its author, states that sorb apples are recommended as a dessert after meals in many Italian households. The "Apicius" cookbook recommends the types with large red fruits. It also gives instructions on how to prepare the sorb apples as a salty dish (see Chapter XI. Service tree – use of fruits). Claudius Galenus (129–200/216), a Roman doctor of Greek origin, known as Galen since the Middle Ages, preferred the service-tree fruit to medlar and recommended that the sorb apples are"used as a drug, not as meat".

Italy

No information on the service tree is found in the work of great Italian horticulturalist Pietro de' Crescenzi (1230–1321), whose work "Liber ruralium commodorum" went on to be cited for several centuries (Tetera, 2006). Dante Alighieri (1265–1321) mentions the sorb apple as a bitter fruit, unlike the fig, that tastes sweet.

«..ed è ragion, ché tra li lazzi sorbi si disconvien fruttare al dolce fico.» (Dante Alighieri, Inferno, XV, 65-66)

translated by Henry F. Cary (1909–14) Adler Museum (1989): "... nor wonder; for amongst ill savor'd crabs it suits not the sweet fig-tree lay her fruit." (Alighieri, 1909–14)

A picture of the sale of the service-tree fruits by Giovanni Cadamosta, 15th century. (repro-photo 3, 2000).

In the 15th- and 16th-century literature we can learn about the use and cultivation (grafting) of the service tree, but primarily there are the (often verbatim) quotations of ancient and so far uncontested writers, such as Dioskorides and Theophrastos, without any new knowledge (Moinet, 2009). The oldest representation of the selling of this fruit was depicted by Giovanni Cadamosto in medieval Italy, Verona or Venice in the third quarter of the 15th century. The illustration probably captures the selling of the large pear-shaped service-tree fruits. The accompanying text says that the fruit was supposed to have the ability to protect from cholera and heal the stomach. The manuscript is kept in the Austrian National Library in Vienna (Kausch, 2000). Italian doctor, naturalist, botanist and entomologist Ulisse Aldrovandi (1522–1605) founded one of the first museums of natural sciences in the world – in his native Bologna.

Aldrovandi painted the service tree in 1553 for the first time, under the term Sorbus domestica (repro-photo 3, 2000)

His rich collections of products of nature are exhibited in the Poggi Palace at the University of Bologna. Part of this collection is the first herbariums and sketches of the products of nature. This is where the very first herbarium item – and a beautiful watercolour painting – of the service tree was preserved. A caption under a drawing for a book he did not manage to publish there is the first occurrence of the modern botanical name – *Sorbus domestica* – which was coined by Carl Linnaeus 200 years later. Linnaeus and Buffon considered Aldrovandi the founder of modern natural sciences. In 1562, Italian Renaissance doctor and botanist Pietro Andrea Mattioli (1501-1577) published the Czech translation of his book "Herbarium or The Herbalist" in Prague with publisher Jiří Melantrich of Aventinum. The herbarium was originally a commentary of Dioskorides' work "De materia medica". Mattioli went on to expand it so each new edition published at the time of his life is broader than the previous one. In 1563, a German translation was published, in 1564 an Italian one and in 1574 a Latin translation was printed in Venice. Botanist and mycologist Pier Antonio Micheli (1679–1737) described and depicted various sorts of service trees for the Grand Duke of Tuscany at the beginning of the 18th century. A multitude of different varieties was described by pomologist Domenico Tamaro (1859–1939) in his work "Trattato di frutticoltura" (Tamaro, 1915). Read more in the chapter about Pomology.

France, Switzerland and England

In France, the first mention of the service tree comes from the 5th century when sorb-apple wine called "curmi" was made; this name has survived in the Irish word "cuirm", meaning "beer" (Lieutaghi, 1975). The sorb-apple curmi was infamous for causing intoxication and having an adverse effect on the intellectual functions in the long run (Moinet, 2009). The study of local names in France shows that the tree served as a spontaneous point of reference in the landscape since the Celtic times (Moinet, 2009). The service tree, called Sorbarios, is on the list of more than 100 plants recommended for the courtly gardens in the "Decree on the Imperial courts" by Charlemagne (742–814). Service trees were supposed to be planted in all courts and their fruit was recommended not only as fruit but also as medicine (Moinet, 2009). There is a mention of the planting of the service tree in an orchard at the Benedictine cemetery in St Gallen in Switzerland from the year 802 (Moinet, 2009;

Realistic illustration of the service tree in the 1557 work of R. Dodoense (repro-photo 4, 2009).

Brütch et Rotach, 1993). In the 12th century the service tree was mentioned in connection to the technological revolution, characteristic especially with the construction of mills, where service-tree wood was valued for its mechanical properties (Moinet, 2009). The beautiful, realistic depiction of a service tree (see picture on the chapter's opening page), perhaps the oldest in French art, can be found in the National Library of France in the work "Grandes Heures d'Anne de Bretagne" by Jean Bourdichon, made between the years 1503 and 1508. Flemish physician and botanist Rembert Dodoens (1517–1585) briefly describes the service tree in his book "Historie de plantes" in the 1557 French edition and complements it with a precise illustration. In his treatise on fruit trees from 1577 Charles Etienne describes service-tree wine as the oldest fruit wine that serves as a model for the production of other fruit wines. Beautiful depictions of bronze and "grey" service trees are in the Treatise on Trees and Shrubs by Saint-Hilaire published in 1824 (Moinet, 2009).

Service-tree treatment

Mr La Bruyere-Champier says: "In 1600, when I studied humanities in Orléans, I suffered from dysentery that doctors were unable to cure and I was on the brink of life and death. Based on the advice of an old woman I started taking fresh sorb apples. Soon I observed the colics to be in remission and my digestion becoming calmer." In the botanical and pharmaceutical dictionary from 1804, the service tree was described as a cooling, disinfectant and astringent fruit suitable (especially just before ripening) for the treatment of vomiting, haemorrhage, both external and into the stomach, and in the form of dry powder for the closing of wounds. It is also recommended against fevers with diarrhoea (Moinet, 2009).

In 1755, in his "Treatise on the trees and shrubs at present cultivated in the open air in France", Duhamel du Monceau (1700–1782), a French doctor, marine engineer and botanist, gave the first scientific description of the "cormier" – the service tree – including the use of the fruit and wood; he does not mention it in the atlas of fruit trees from 1768, though. It was systematically classified by Carl Linnaeus in 1753: "We find *Sorbus domestica* in the woods in 'Flore Française' from 1778. Lamarck mentions the service tree *Sorbus domestica* in the forests

The bronze and grey service trees in the Saint-Hilaire herbarium (1824).

of Alsace and Provence." In 1793 we can find the service tree in a regional catalogue as a tree suitable for alleys and boulevards. It is recommended for its decorative appearance as well as fruits (Moinet, 2009). The cultivation of service trees together with an intensive introduction of apple trees and vine in Central France went on till the 18th–19th century thanks to the egalitarian tradition of the family law concerning land inheritance, which is evidenced by such regions as Sarthe and Maine-et-Loire, where there is a heavy concentration of the toponym "Le cormier" (Moinet, 2009). In the 18th century, service tree juice was regularly added to apple cider in France, Switzerland and Germany (Paganová, 2008).

Jean Thore (1762–1823), a French botanist and doctor, mentions one of the specific uses of the sorb apples – in a very roundabout way "Service tree fruit, which is so bitter that it contracts the lips and dries up the oral cavity, is used in potions for a certain kind of women to prevent the relaxation of a certain organ that is brought about by the undertaking a certain activity." (Lieutaghi, 1975).


FLORE FRANÇOISE
OU
DESCRIPTION SUCCINCTE
DE
TOUTES LES PLANTES
Qui croissent naturellement EN FRANCE,
Disposée selon une nouvelle méthode d'Analyse, & à laquelle on a joint la citation de tous ceux les mieux approuvés en Botanique, & de leur usage dans les Arts.
Par M. le Chevalier DE LAMARCK.
Tome Troisième.
A PARIS,
DE L'IMPRIMERIE ROYALE.
M. DCC. LXXVIII.

Service tree is briefly described in the "Flore Française" by Lamarck, 1778 (repro-photo 4, 2009).

The Representation of the service tree L. Klein's "Our forest trees", 1839.

The service tree fruit was introduced to England from France in the 16th century and it has been called the "service tree" or popularly the "witty pear". The name is probably derived from the taste of unripe fruits. The fruits were appreciated mainly in London markets, in Oxfordshire, Kent and on the Isle of Wight (Eland, 2008). The first written mention of the occurrence of the service tree in England comes from the year 1677 from Alderman Edmund Pitt Worcester, who discovered the tree in Wyre in Worcestershire. The tree was destroyed by fire in 1862, which was allegedly started by a poacher as an act of retribution (Hampton et Key, 1995).

The "cormé" controversy in France

In 1902 the production of the "cormé" drink was still a source of considerable local incomes. This is illustrated by the dispute between the administration and Mr de Lambilly, a land owner in the vicinity of Nantes, who had a relatively large number of service trees. He harvested the fruit from these trees, made must from it and distilled it after fermentation. One day the administration officers fined him for not noticing them in advance and not paying a license fee. Mr de Lambilly argued that as an owner he enjoys the privileges of wine makers and that the "cormé" drink is a must, which is in line with this. The administration refused to be considered "cormé" for must and the case was submitted to the court in Rennes, which ultimately decided in favour of the owner: drink "cormé" is once and for all the must.

In 1898, M. A. Trouelle, a pharmacist from Trouville on the north-west coast of France, laconically sums up the culture of service trees outside France: "In Switzerland the service tree is not used for the production of drinks, and in England the tree is not appreciated any more." Trouelle sees no future economic benefits of service tree cultivation. "The drink, be it plain or in a mixture, will not be able to face up to the competition of apples, whose cultivation keeps improving, as well as their preservation and the improvement of their varieties on the relevant land." On the other hand, Eugene Glady, the owner of the land around the town of Agen, wrote in 1885 that in addition to yielding excellent fruit the tree can embellish parks and roads, and he adds that in Bordeaux, Toulouse, Agen and many other towns in the south of the country the service-tree fruit is sold at markets, sometimes over-ripe, sometimes semi-ripened, at high prices (Moinet, 2009).

Later, other historical sources do not say anything about this topic – as if the service trees disappeared from the rural economy. The Vilmorin-Andrieux & Cie orcharding catalogue from 1910/1911 still offered service-tree seeds, but in 1920/1921 they were no longer there (Moinet, 2009). In his excellent book "The Beautiful Fruit of France", published in 1947, G. Delbard distinguishes 4 varieties of medlars, 18 varieties of chestnuts, 8 kinds of quinces, 11 varieties of hazels, but the service tree was not mentioned even once. The service tree actually disappeared from the economic environment. Possibly, the tree was no longer planted because of the widely spread opinion that it grows slowly and that it does not give enough fruit at the age of 30. Such long waiting is incompatible with the impatience and business typical of our times (Moinet, 2009).

Germany, Austria

Hildegarda of Bingen (1098–1179), a German Christian mystic, natural scientist, doctor, music composer and writer, recommends service-tree fruit as a medicine (Moinet, 2009). The first complex descriptions of the service trees can be found in printed books. They are often older books that are only amended and translated into German.

In the 1485 edition of the book "Hortus sanitatis" by German botanist and pharmacist Johann Wonnecke von Kaub (1430–1504), printed by P. Schöffer, it is emphasised that ripe sorb apples must be cut in half before drying.

They can be used to treat bowel disorders; sorb apples are compared to medlars in this work *(Mespilus germanica)*. In his Latin herbarium "De historia Stirpium" (1542), Bavarian botanist Leonard Fuchs (1501–1565), after whom fuchsia plants are named, lists the service tree among fruit trees.

A service tree with yellow fruits in the 2nd edition of Fuchs's 1543 herbarium (repro-photo 3, 2000).

Fuchs's herbarium contains an illustration of the service tree accompanied by the description "Sorbus datum Spierling". In the second, 1543, edition the same coloured wood engraving is used, with the description "Spierling CCCXXVII". It is the first piece of evidence of the German name of the service tree: Speierling (see fig.). The wood engraving depicts yellow pear-shaped fruit and a strange picture of what might be flowers or young leaves. In his 1557 Herbarium, German doctor and botanist Adam Lonitzer (1528–1586) quotes Pliny, who had discerned the apple and pear shapes as early as in his time. The depiction of the service tree strongly reminds us of the one by Fuchs (see fig.). In his 1546 Herb Book, German botanist and doctor Hieronymus Bock (1498–1554) describes Upper-Rhine service-tree fruit as follows: "Its yellow fruit matures in autumn – it is red on the side touched by the sun." Bock also mentions the period knowledge that there are male and female service trees (Nyári, 2005). Mattioli's Herbarium, published in Germany in 1563, contains a beautiful wood engraving of a service tree called "Zämer Gperrverbaum" (Kausch, 2000).

Wood engraving from A. Lonitzer's 1716 Herbarium.

S. domestica L., der Speierling, hat kahle Knospen, und birnförmige, über 2,6 cm lange, grünlich-gelbe, roth-bunte Früchte, welche, wenn sie „teig" sind, gegessen werden. Er blüht im Mai und Juni, und die Früchte reifen im September; er wächst langsamer, als der vorige, ist aber von längerer Lebensdauer, wird auch höher und dicker, und soll erst nach 200 Jahren seine volle Größe erreichen. In Frankreich soll es Exemplare geben, welche 1000 Jahre alt sind. Er ist ursprünglich in den Gebirgen von Oesterreich, Krain und dem Littorale zu Hause. Das Holz ist außerordentlich fest und zähe, röthlich-gelb, im Kerne braun und meist schön geflammt, und wird von Schreinern und Wagnern sehr geschätzt.

S. hybrida L., die Bastard-Vogelbeere (S. Aria × aucuparia), mit nur fiederspaltigen Blättern, sonst dem Vogelbeerbaume ähnlich, findet sich auf dem südlichen Abhange des Thüringer Waldes; in Norwegen allgemein in den Tiefen bis zum 63°.

The service tree is briefly mentioned in the German "Botany for foresters", which says that the tree can live up to 1000 years (Nobbe, 1882).

Service-tree item in Ratzenberger's herbarium from the 2nd half of the 16th century (3, 2000).

Large-fruit service tree in the 1778 "Flora Austria" (3, 2000).

Depiction of a service tree by F. L. Krebs, 1826.

At the end of the 16th and in the 17th century the service tree was often mentioned by Cibo, Ratzenberger and Chiovenda and it is also evidenced by the first herbarium items (see figure) (Kausch, 2000). Empress Maria Theresa (1717–1780) introduced tree alleys along the roads in the Austro-Hungarian Empire to provide shade and fruits for soldiers and beggars passing by.

In 1740, service tree cultivation was mentioned in Bad Homburg and Frankfurt am Main. In the 18th century, pastor and pomologist from Kromberg, Johann Ludwig Christian (1739–1813), gave a detailed description of the cultivation, the varieties and the use of service trees around Frankfurt am Main, both as fresh and dried fruit , for wine-making and so on. Large-fruit service trees are presented in the 1778 "Flora Austria" by N.J. Jacquin, in pictures by I. Walter (see fig.).

Italian pomologist Tamaro (1915) describes the famous manufacturing of apple and pear cider (fermented fruit juice) containing sorb-apple juice around Frankfurt am Main. Together with the popular sorb-apple spirit, this apple cider has been produced in Hesse, especially around Kronberg, until today.

Wines made with the addition of sorb-apple juice

Since the Middle Ages the adding of sorb-apple juice has been practiced in Germany. The juice stops fermentation and improves the flavour and colour of wine made from grapes (till the 19th century in Hesse) and later also of apple cider. "Sorb apples are harvested by shaking the tree branches. They are collected ripe, but not overripe, they are crushed in a press. Fifty to sixty litres of sorb-apple juice is mixed with 1200 litres of apple juice. Such drink has double the market value than a drink without the admixture of sorb-apple juice. Also sorb-apple spirit is highly appreciated" (Trouelle, 1898 in Mornet, 2009).

Hungary and Slovakia

In Hungary, the very first mention of the service tree as a fruit tree comes from the 1055 text "Nova hortum plantatio num", which deals with the origin of cultural crops and the centres of their cultivation from the oldest times (Surányi, 1985). Farmsteads in the Roman province of Pannonia (today's Hungary) used to produce large quantities of fruit and wine, including those made of sorb-apples (Gyulai, 2001). Service-tree seeds were found in a medieval well in the Buda castle, which shows the use of the service tree in this country also in the middle ages. Rapaics (1940) and Nyári (2002) give evidence of the fact that solitary service trees used to become the cores of orchards and gardens (see chapter II. 6 – Service tree and the beginnings of pomology). Some attention was given to the service tree also in modern times. In 1859 a publication by Ferenc Entz, entitled "On the service tree" was written. In 1896, Rudinai Molnár István described the service tree as a fruit tree, without which the life of apple wine could not be maintained.

Service tree by Theodor Dietrich: "Forest flora of Germany" (1850)

Bronze sorb apples from Hungary (Surányi, 1985).

Dezső mentions service tree in the magazine Ovocinár (Fruit Grower, 1905) as a great fruit tree that grandparents give to their grandchildren as a fruit tree as the source of income from the sale of fruit.

In the Slovakian countryside the information that in the 16th century the serfs collected service-tree fruit for the army that fought against the Turks and brought the dried fruit to the castle chambers (Mikolajová-Stoličná, 2004). In his work "Zelinkár" (Herbalist), Juraj Fándly writes about the service tree the following: *"Crushed service-tree fruit boiled in water together with leaves stop a runny tummy to those who wash themselves with such water"* (Fándly, 1793). Slovak botanist and evangelical priest Holuby describes the everyday use and cultivation of service trees in West Slovakia as late as at the end of the 19th century (Holuby, 1888). Sorb apples also are mentioned in the story

"The Štávnice Idyll" by the Czech writer and journalist Jaroslav Hašek (1883–1923): "... If we add the image of lovely countryside flooded by golden sunshine and lush green meadows we understand why the people in Šťávnice have the joy of life, particularly when they know that the sun shines on their vineyards to make the grapes go red, sorb apples ripe and that the meadows have the sweet-smelling hay that makes the cattle strong – so when the sun shines on the plates in the dining room it sees its work again" (Hašek, 1920).

The first depiction of the service tree in Czech printed literature, 1517 (Black, 1517).

Depiction of the service tree from the first Czech edition of Mattioli's herbarium (Mattioli, 1562).

Bohemia and Moravia

In Bohemia, sorb apples have been known since the turn of the 10th/11th centuries, when they were added to mashes and sauces (Beranová, 2011).

The oldest description of the service tree in Czech comes from the year 1517.J. Černý (1456–1530), in his work "Kniehá lékarská, kteráž slove herbář" (A Medical Book Called Herbarium), writes: "Sorb apple, the round yellowish forest fruit. It is earthy, which is where its bitterness comes from. It is a good food for a funny stomach and bowel, it stops diseases from fats, from hot and wet and it prevents the hot rising to the head. It is a remedy for the choking with blood and meals not staying in bowel and it cures fever. Eaten before a meal it hardens, after a meal it softens, because astringents squeeze the stomach" (Black, 1517). The text is accompanied by illustrations of a service tree (see fig.). The herbarium was printed in Nuremberg by printer Hieronymus Höltzel and was covered by Mikuláš Klaudyán from Boleslav. It was aimed at ordinary people and was meant to be used mainly as a home medical book. Černý reduced the number of quotations by classical authors and concentrated on the practical use of plants. It was the most popular medical book in this country – before the publication of the Czech translation of Mattioli's herbarium. Klaudyán got illustrations of German origin for this work. The depictions are very simple and lack basic determination traits. Some of the illustrations of plants repeat next to several species. However, this is probably Klaudyán's mistake, not Černý's (Bohatcová, 1993). In 1554 Pietro Andrea Mattioli arrives to Prague as a personal doctor of Arch Duke Ferdinand of Tyrol, who significantly supported the publication of the herbarium (Bohatcová, 1993). This is why the first publication of Mattioli's herbarium outside Italy was the Czech translation from 1562 by Tadeáš Hájek z Hájku (1525–1600), who amended it with his knowledge of the Bohemian environment. The descriptions distinguish different botanical species: service tree (oskeruše) – woskeruše, rowan (jeřabina) – rženřabina, břek - břekyně. This was the first time that the scientific name, *Sorbus domestica,* spreaded thanks to print.

Service tree in the second edition of the Czech translation of Mattioli's herbarium (Mattioli, 1596).

Wine pressing pictured in a 1582 book about wine-growing from Vlčnov and Havřice (Beranová, 2011).

The interest in literature grew, which is why Daniel Adam of Veleslavín decided to publish a new issue of the herbarium. The translation was done by a professor at the faculty of medicine, Adam Huber of Risenpach. New wood-block illustrations had to be created because Mattioli took the wood blocks with him on his departure from Bohemia (see figure). In the next Czech translation of the herbarium from 1596 by Adam Huber of Riesenpach, the service tree is described as follows: "The service tree is of two sexes, the male has round apples while the female has oblong ones... Domestic or garden service tree is a well-known tree in Italy, but in Bohemia it is found rarely and it is not known to everyone. In the garden of His Grace the Emperor in Prague there are several young trees. It is harvested in the autumn, it is bound or hung or placed on hay or straw to mature and soften" (see figure on page 32).

There are no more mentions, not even J. A. Comenius (1592–1670), who must have known the service tree during his childhood in southeast Moravia, does not mention it in his work "Orbis sensualium pictus" (1658). In the 17th century, service trees were grown in Moravian Slovakia and their fruit was sold on the markets. There is an interesting report without context by a Velehrad official from the year 1692, who states that the toll of "6 kreutzers for a back bucket of peaches or sorb apples" was collected from the people from the cloister on their way to the Kroměříž market (Tetera, 2006). The interest in this woody plant in the Strážnice region in the past is documented by a note in an 1834 chronicle where the chronicler G. Volny mentions beautiful service tree trees in the Strážnice manor.

F. L. Čelakovský (1868–1883) mentions the service tree briefly: "It is planted rarely in our fruit gardens, even more so in the fields, for instance in Litoměřice near Pokradice and on the Soví Hora mountain" (Prudič, 1998). The German-speaking inhabitants of the Bohemian Central Highlands knew the tree under the name "Wasserrutschken", not under the usual German "Speierling" (Sedlaczek, 1930 in Kubát, 2002). From the survey of the Czech Department of Agricultural Council in Moravia carried out at the end of the nineteenth century we learn that the biggest and the most beautiful service trees grow oin the Strážnice region, especially around the Tvarožná Lhota village.

Border Trees

We have information from the 18th century about large service trees that were used as border trees. There is an entry in the magistrate book of the Napajedla town from 1789:

"... a dispute concerning a large service-tree pear was decided "; in the list of plots there is the following entry: "... vineyard on the plot near the large service tree". The record evidences the presence of a massive service tree of geographic significance. It was considered a point of reference for the cadastral division of the plots (Tetera, 2006). The memorable Věstonice service tree (trunk circumference: 320 cm, estimated age: 250 years) near the Czech-Austrian border in Dolní Věstonice was planted as a starting orientation point for the delimitation of vineyard plots in the Theresian cadastre (oral communication, F. Michna, 2009).

The memorable Věstonice service tree (red) is a border tree of the Theresian cadastre (F. Michna, 2009).

In the 1930s the farmers brought service trees from Tvarožná Lhota to the market in Brno (Dvořák, 1914). The first photographs of service trees on our territory were taken by J. E. Chadt-Ševetínský for his work "History of forests and forestry in Bohemia, Moravia and Silesia" published in 1913. It seems that in our countries the service tree has been a historically rare and little known woody plant.

One of the first photographs of service tree from Damborice inn Moravia (Chadt, 1913).

Mrs Hošková and their family service tree on the Žerotín hill in Strážnice (1, 2007).

Records of service trees at the turn of the 19th and 20th century

"The service tree grows in forested European uplands as a shrub or a tree. It flowers in May; its red, egg-shaped fruit tastes tart at first, but when it freezes it becomes tasty and palatable. The fruit is used against chest diseases, diarrhoea and catarrhs. In some regions they make it into a drink similar to wine or brandy. In veterinary medicine strong decoction of this fruit is used in large doses as a safe drug against splenic fever in cattle. Hard wood is suitable for waterworks and the bark for leather tanning. There are several species. One of them is generally called rowan or little rowan" (Hynek, 1899).

5. **Oskeruše**[1] neboli **oskeruch**[1] (P. sorbus[2] Gärtn., Sorbus domestica[3] L., Hauseberesche — obr. 845) podobá se lichozpeřenými listy a bohatými, chocholičnatými latami bílých květů, jež objevují se v máji, velice jeřábu; má však ve květech 5 čnělek a plody žluté, na straně ke slunci obrácené červenavé.

A mention of the service tree in Polívka's 1904 Názorná květena zemí koruny české (Illustrative Flora of the Lands of the Bohemian Crown).

II. 2. Service tree in art

The service tree has been known since the times of Ancient Greece; however, no image representations have survived. The earliest known representations come from the Late Middle Ages and can be found in herbariums, graffito, and murals in both secular and church buildings. An interesting representation can be found on the famous copperplate by Albrecht Dürer "Adam and Eve" from 1504 where Adam – according to W. Kausch's interpretation (2000) – is leaning against a service tree and Eve against an apple tree. It seems that the service tree was a prototype of a beautiful woody plant (see Fig.). In the Renaissance and Baroque periods, the service tree was the occasional subject of fruit still lives we can admire in exhibitions in castes, chateaus, and galleries. Most often it can be found in the works of Italian masters, such as Vincenzo Campi (1536–1591), Jacopo Zucchi (1540–1596) or Giovanno Garzoni (1600–1670) (see Fig.). The 18th century saw the development of the graphic technique of copperplate engraving that, in combination with watercolour, facilitated more precise rendering of the model. A copperplate by Jacob Well from 1768, deposited in the Austrian National Library in Vienna, faithfully depicts a branch of a service tree with fruit covered with lenticels. In modern times, the service tree has become – among other things – an artistic subject used on postage stamps, e.g. in Luxembourg and Slovenia (see Fig.).

The portal of a Renaissance-style church gate in Florence with a sculpture depicting quinces, medlars, and sorb apples (1, 2010).

A possible representation of a service tree on a column situated at the Liberty Square in Brno (1, 2013).

The "Adam and Eve" (1504) copperplate by Albrecht Dürer with a possible representation of a service tree (3, 2000).

A representation of a service tree in the Garden of Eden (a detail) by Zucchi (1570); Uffizi Gallery, Florence, Italy (1, 2010).

Fruit still life by Vincenzo Campi from Cremona, Italy, entitled "La Fruttivendola" (a detail) with sorb apples in the bottom right corner (Pinacothèque de Brera, Milano).

A still life with sorb apples (a detail) by an unknown author from the 18th century; Červený Kameň Castle, Little Carpathians, Slovakia (1, 2010).

A branch of a service tree on a copperplate by Jacob Well, 1763 (repro-photo 3, 2000).

Mannerist-style sorb apples by Italian paintress G. Garzoni, 1640.

Postage stamps with service trees; Luxembourg, Bosnia and Herzegovina

Service tree in applied art – a pattern on a table cloth; Croatia (1, 2012).

II. 3. Service tree in popular rendition

Service tree in Moravian oral tradition

The service tree also penetrated into the oral tradition of Moravian Slovakia. It was mostly a symbol of poverty or youth, such as in the following saying: "One old woman, two old women are distributing sorb apples." A little impish child who "had ants in the pants" was told:

"You're like a little sorb apple." (Tetera, 2006) The reason probably is that although children look nice and cute, they may act in a cunning way and get into mischief, which is symbolised by beautiful but sour, astringent sorb apples. However, people who know how to deal with children and let them "ripen" are rewarded by a pleasant "taste". Adolescent girls used to respond to boys' interest: "Why bother with us? After all we are still like sorb apples." This means the girls were young and attractive but yet immature like unripe sorb apples.

Oskeřica or *odřeňa* (from *oskeruše* – sorb apple) was a nickname for a young girl who knew her way and was able to act quickly. These words probably reflect the resistance and durability of sorb apples (Hrdoušek et. al., 2003). There are also a few tunes in folk songs from the border of Moravia and Slovakia. In one of them, rebellious Janko is being asked: "Why didn't you hide away from them, Janko? Who brought you up? Wild pears and sorb apples, oh green grove." And in another song from Upper Moravian Slovakia (the Horňácko subregion) people ask: "What do you get to eat, boy? Wild pears and sorb apples." (personal utterance, B. Rychlík, 2010).

Children are like unripe sorb apples – beautiful and mischievous (Šebestiková, 2012).

A representation of the service tree on a tie (2, 2011).

A representation of the service tree in a publication by D. L. Oskamp, 1813.

The origin of service trees in Moravian Slovakia

A litography entitled "Service tree, the tree of Moravian Slovakia"; F. Pavlica, 2012.

"The service tree is a mysterious plant surrounded by a great deal of stories about its origin here in Moravian Slovakia. Legend has it that service trees were brought by the Roman military forces. The Romans took seedlings with them and planted them wherever the army went. The trees served as labels for their routes or territories and also as border stones. In old times, the so-called Hungarian Trail (or the trail of Sudoměřice) led from Slovakia through the foothills of the White Carpathians all the way to Moravia. The trail is lined with service trees today. According to other folk tales, it was only Turks and Tatars who brought this species from the Balkans to be able to make their own wine and drink it in the shade of the trees. Invasive Mongolian tribes that occupied the town of Strážnice reportedly had dried sorb apples with them as a medicine for dysentery and diarrhoea. Then, seeds were spread by animals. It is believed in the Moravian Slovakian region of Zálesí that only the hoopoe can make the species' seed germinate. And because there are only a few hoopoes, there are also few service trees. In Moravian Slovakia, this effect is sometimes ascribed to beautiful waxwings, which are rare today as well." (J. Gazda in Hrdoušek et. al., 2003).

Service tree in superstition

In the past, people ascribed magical meaning to service trees, as the legend goes in Slovakia. A farmer used to snap off a piece of twig from a service tree after the birth of a calf to whip the newly-born animal symbolically. Only then he gave a name to the young cow. He had to be careful about choosing a fresh twig during the birth of the calf and break it off before the sunrise using a copper knife only. This twig was not thrown away. The husbandman hung it above the door of the stable and accompanied it with pieces of an egg shell. The aim of this habit was to strengthen the healing effect and fertility of the particular service tree. Elderly people remembered that fruit and juice from such service trees were added into cow's milk, which had favourable effects on one's intestines and stomach (Mikolajová-Stoličná, 2004).

In England, wood from service trees supposedly helped in the protection against evil spells cast on livestock and people by witches (Eland, 2008). Grater (1999) states that in Germany people believed that branches of service trees laid on roofs protected houses from lightning and that cupboards and chests from the wood of service trees protected their contents from thieves.

A service tree in Moravian Slovakia; F. Pavlica, 2012.

Service tree and lightning

Mr. Hořák recounts: "At this point I'll mention a strange phenomenon of a bad sorb apple harvest. It happened one year, there was not even a single fruit on the whole service tree. Once, half of the treetop was covered in fruit from top to bottom, the other half had nothing – as if somebody split the harvest in half with a swish of a magic wand. When I was young and we got back from our vineyard in spring, I remember my grandmother asked every time if our service tree was already in blossom. If it was, she used to say: 'Let's hope no storm comes. Otherwise there aren't going to be any sorb apples!' My mother confirmed that when service trees were in bloom and a storm came, blossoms lit by a lightning fell off and the trees gave no fruit. I didn't take it too seriously when I was young. However, with age, people reach different insights about past things, about the experience of one's ancestors and their stories. When our service tree was in bloom, a storm was approaching so I drove home to avoid it. After two days I arrived in the vineyard and discovered that darkened blossoms were falling off. There was no harvest. Several years later, I worked in the vineyard again and the service tree was in bloom. Clouds were looming up from the west but they stopped about twenty kilometres away and stayed there for more than an hour. Then there were two subtle lightnings and in another hour the clouds were all gone. I wondered if such a weak thunderstorm would have any effect on the blossoms too. It did. In the autumn, there was no fruit on the west half of the tree. Later, after the tree finished blossoming, the gleam of lightning couldn't harm the fruit." (in Hořák in Hrdoušek et al., 2003)

A service tree with fruit in only one part of the treetop; Tvarožná Lhota (2, 2008).

A poem about a sorb apple

Rosy cheeks covered in freckles, a sour taste of unripeness.
That time, still insipid of flavour, lips would like to be kissed. It is better not to rush and leave them alone for a while.
Only in summer, never ahead of its time, the sun crowns the immature beauty.
The cheeks turn gold and that is the time.
The time of harvest. The time of feast.
They are fully ripe. Ready to be picked. Disposed of their sourness, they lure to be bitten into.
They have a sweet smile and invite to be kissed. (Dundr, 2013)

Ripe sorb apples in the front and two unripe sorb apples in the back (L. Zubák, 2009).

Folk wisdom from Moravia

"Anyone who plants a service tree and takes a swig of sorb apple brandy will live to a ripe old age!"
"Romantics plant roses, good chaps plant service trees."
"Sorb apples are a cure for frail health."
"Drinking sorb apple brandy is a life, tasting it is a science,
and talking about it is an art."
"When you eat sorb apples or drink sorb apple brandy, there is no chance of getting diarrhoea and you live well!"
"When you observe a graceful tree, you think: If only we lived that long!
Let's praise this Moravian tree and thank our fathers and grandfathers!
May it adorn our country for a long time. God, give us your blessing!"
(Polášková in Hrdoušek et al., 2003)

Popular sayings about service trees and sorb apples in France and Italy

The service tree likes hard soil.
"Sorb apples are exceptional fruit: it lasts 100 years until they arrive, they stay for 100 years and it lasts 100 years until they are gone."
"He ate sorb apples" is said about someone who is a tough farmer, a villager.
"If you eat a green sorb apple, you can't whistle anymore."
"If you eat seven green sorb apples, your gender will change!"
Sorb apples were eaten by poor people – they were eaten from 'crocks'.
Cormé – an alcoholic beverage made from sorb apples is a 'casse-bon-homme' ('a chap-buckler') or 'casse-patte' ('a knee-buckler'), i.e. strong wine.
"Apathetic/stupefied as if they drank sorb apple juice" is said about people who are naive and very simple.
(Moinet, 2009)
In Italy, people mockingly say about those who do not know what to do with their lives: "First you should eat seven (or nine) sorb apples without pulling a face."

Mr. and Mrs. Polášek by their ancestral service tree on the Žerotín hill near Strážnice (L. Polášková, 2002).

Mrs. Vítková with her grandson by their ancestral service tree in Tvarožná Lhota (1, 2007).

II. 4. Service tree and local names

Coats of arms of the towns of Oskořínek near Nymburk, Jenčice near Litoměřice, Zlámanec near Zlín, and Žeraviny near Strážnice

We can also encounter the service tree in the history of European local names. In the Czech Republic, the service tree appears in the names or coats of arms of the following towns: Oskořínek near Nymburk, Jenčice near Litoměřice, Zlámanec near Zlín, and Žeraviny near Strážnice. In the cadastres of certain towns there are local names that refer to the service tree (*oskeruše*), e.g. the Oskorušné forest belonging to the cadastral communities of Březnice and Bohuslavice near Zlín where, unfortunately, almost no service trees can be found at present. The service tree is embedded in personal names as well. Surnames include Skoruša (2x) and Voškeruša (52x), which occur mainly in South Moravia, and Oškera (250x), which appears mostly at the border of Moravia and Slovakia.

The "Oskorušné" forest by Bohuslavice near Zlín (map of the Czech Tourist Club, 2007)

The origin of the name of the Oskořínek town

The first mention about Oskořínek dates back to the 15th century – the record says "*w Oskorzinie*" (in Oskořínek). Oskořínek is a diminutive form of the original name Oskořín. The is town probably called after its owner or founder, a person named Oskor, to which an -in suffix was added. The popular interpretation of the origin of the name Oskořínek is quite interesting: "Oskořínek received its name after the *oskorůží* shrub that resembles the hawthorn. The word *oskeruše, oskoruše* – service tree). It is an old Slavonic name for a shrub that grew in excessive numbers in the area of our present-day town." (*www.oskorinek.cz*)

Towns in other countries situated in the vicinity of areas with increased occurrence of service trees obtained their names after the tree as well. The Berkenye town under the Tokay Hills in Hungary is called after the wild service or the service tree. The German town of Speyer, known since as early as 150 AD as a Roman settlement, possibly bears its name after the word *Speierling*, meaning service tree (Prudič, 1998). In France, hundreds of local names were derived from the French equivalent for a service tree. The topographical dictionary from the region of La Sarthe, published in 1950, is very rich in such information. 1896 names (personal, local, etc.) were identified to have come from the word for a service tree.

A frequency analysis of tree names in local names suggests that the service tree ranks fourth (184 names) after the oak (453), alder (267) and birch (241), which is quite unexpected for a fruit tree that used to be planted artificially. This is evidence of its former significance in the economy of the rural department of Sarthe. The name of the town of Cormes (*cormes* – sorb apple) from the 4th century, lying in the vicinity of the town of La Ferté Bernard,may serve as one of the examples.

The local name of Cormier, meaning "service tree", in Saint-Symphorien comes from the 11th century (4, 2009).

The 11th century (1075) saw the emergence of the local name of Cormier (*cormier* – service tree)in Saint-Symphorien. Sorbo is a south French and Italian local name for someone living near service trees or making use of their fruit (Moinet, 2009). For more information please refer to Chapter VI. – The distribution of the service tree. Local names gradually passed into personal and family names. One of notable people called after the tree species was Robert de Sorbon (1201 – 1274), the confessor of King Louis IX who was born in the town of Sorbon near Rethel in south-eastern France. In 1257, he founded the theological college of the Paris University – Sorbonne, whose name later became synonymous with the whole university.

Robert de Sorbon (1201–1274), founder of the Sorbonne college.

In Italy there are quite a few towns called Sorbo (service tree). Sorbo is the name of a hamlet by the village of Tagliacozzo near L'Aquila, the village of Sorbo-Ocagnano is located in Corsica, the village of Sorbo Serpico is in Campania, and the village of Sorbo San Basile lies in Calabria. A number of other Italian local and personal names are derived from Sorbo: Sorbi, Serba, Sorba, Sorbelloni, Serbera. Most of them appear in southern Italy, especially Sicily.

The service tree is even present in the names of some celebrities: actor Kevin Sorbo, boxer Daniel Cormier.

The coats of arms of the towns of Sorbier (southern France) and Cormier (northern France).

The coat of arms of the town of Sorbo San Basile in Calabria, Italy, and Sorbo Serpico in Campania, Italy.

II. 5. The history of the name "service tree"

Pen-and-ink drawings of the greatest memorable service trees in Moravian Slovakia: Adamec's and Karel's service trees, over 400 years old (V. Lepš, 2005).

More detailed study of oral tradition shows that in history, interchanges and amalgamation of terms occurred when describing present-day botanical species. In southern countries, *sorbe, sorbo, sorbum, serbal,* or *sorbus* are words used to denote the service tree as well as other species of the Sorbus genus. As recently as in 1826, Risso identified the *aucuparia* and *torminalis* varieties when describing the *Sorbus domestica* species (Risso, 1826). In Slavonic Europe, the mountain-ash (*křežab*) and the service tree (*voskeruše*) were often taken synonymously. Sometimes other intra-genus distinctions were made, as stated by T. Hájek from Hájek in Mattioli's Herbarium (1562). Consequently, in many translations of historical works, it cannot be stated for sure what species the text is talking about although the translation uses a particular rendering for the word denoting the species. The translation of the Finnish national epic poem *The Kalevala* purportedly describes a mountain-ash / service tree: "Birches sows he in the marshes, in the loose soil sows the alders, in the lowlands sows the lindens, in the moist earth sows the willow, mountain-ash in virgin places..." (Lönnrot, 1980). However, the occurrence of service trees in Finland has not been recorded in the past nor the present. Still, the service tree has its traditional namings in all European languages (Kausch, 2000). Moreover, for many nations, especially from southern Europe, the service tree was the first species from the *Sorbus* genus they were able to distinguish. *Sorbum* (service tree) gave the name to the whole *Sorbus* genus. In all the European locations where the service tree has been widespread up until today, it was regarded as a domesticated woody plant as early as in the Early Middle Ages. The origin of the names for the tree and its fruit alone provides evidence of it historical usage. The Italian word representing the service tree (*sorbo*) stems from Latin *sorbus*, *sorbum*, and *sorbeo*. The German rendering *Sperberbaum* comes from Greek. The Slavonic name for the service tree is also based on Greek but is derived from a different word. In France, history even gave two names to the service tree: *cormier* is used in central and northern France and is of Celtic (Gaelic) origin – *corme* is the name for fruit, *cormé* denotes a beverage, and *curmi* a fermented beverage. In southern France, the service tree is called *sorbier*, which is derived from the Latin word

sorbum; *sorbe* is the name for its fruit and *sorbé* the name for the beverage (Moinet, 2009). The person to have first used the word *sorbum* to denote the service tree was Marcus Porcius Cato (200 BC). The fruit of the service tree was used in the Middle Ages as a medicine for gripe and diarrhoea. The disease was called *tormina* and the medicine *torminalis* (sorbitol). Based on this, the wild service obtained a scientific name *Sorbus torminalis*. Diarrhoea protection is also reflected in an old German word for the service tree: *Arschschütze*. *Sorbum* and therefore also *Sorbus* can be derived from the Latin word *sorbeo* that carries the meaning "absorb". The service tree's fruit absorbed the liquid content of the digestive system. However, some authors interpret the name of the *Sorbus* genus as coming from different words, e.g. Celtic *sorb* – sour (Koblížek, 2006).

Romance languages borrowed the naming from Latin (*sorbus*) or, to be more precise, medieval Latin (*sorbeo*).

A comparison of the service tree, mountain-ash, wild service, and whitebeam on a woodcut by Thomas Fanshow, the author of an extensive herbarium (Fanshow, 1673).

Not only Romance languages, but others are also based on Latin (*Serves, Syrfe*): English *service tree*, modern Greek *σουρβιά* and Albanian *shurbë*. The Albanians have other names for the service tree too: *vadhë, dial, vodhë, vosë, vejlit*; in southern Italy it is *vaile* that was probably borrowed from the Greeks (Machek, 1971).

The German word for the service tree comes – probably because of the shape of the leaves – from the Greek word ὀροφή, meaning "a rafter". The German equivalents of the Greek rendering are *Sparre, Sparren, Dachsparren*, and *Sparrenwerk*. The Middle Ages gave birth to a new term for the service tree – *sperboum, spirboum*. The words *Sperberbaum, Speierlingsbaum, Sperbe, Spierbaum, Spierling* were also new (Barabás, 2011).

The Slavs probably identified the Greek term for the service tree (*ὄα, ὄη, οὴ, οὰ, ὠά, ὠά, οὖα, ṓ; ὅον* denotes its fruit) with a similarly-sounding word for a sheep skin (*ὄα, ὤα, ṓ*) and called both the tree and its fruit "skin" – *skora, skoruša* (Kritsch, 1822). *Sorbus domestica* is therefore rendered as *skoruša, skorša, oskoruša,* and *oskoruša* in Macedonian, *oskóruš, skóriš*, and *skórš* in Slovenian, *oskoruša* in Croatian (the vernacular form being *skorš, oskorš*, and *skoruša*), *skóruša* and *oskóruša* in Bulgarian (Barabás, 2011). *Skoruša* was borrowed from south Slavs by Romanians in the form of *scorúș* (service tree) and *scorúșă* (sorb apple). The service tree (*Sorbus domestica*) grows in lowlands, while its cognate mountain-ash (*Sorbus aucuparia*) prefers mountains. The service tree and the mountain-ash have similar leaves as well as fruit and that is why Romanians call them *scorúș de munte* (mountainous service tree) or *scorus sălbatic* (wild service tree) (Machek, 1971). Romanian highland herdsmen

Prwnj Kniha Herbáře/

O Wosskeruši, Kržekabině a

Břeclyni. Kop. LXXXVI.

Pohlawj a Rozhzl.

Osskeruše dwogího gest Pohlawj/ totiž Samec a Samice. Samým Owocem dělí se a rozeznáwagi. Nebo Samec má Gablicka okrauhlá/Samice obdelaužná, gako Wegce, podobnegssí k Hrussce. A též Gablicka na Samcy gsau woaná a libé chuti/na Samicy ne tak woaná/ chuti přikré a trpké. Toto dwogé Pohlawj opět dělí se na domácý a plánc. Domácy aneb zahradnj Wosskeruše we Mlasších gest známý Stromu/ w Czechách pohlédku se nachazý/a ne wsiem gest známý. W Zahradě Geho Mil. Cysařské w Praze mnohk mladistrých Stromkůw se nachazý. Má Pětiz rowný a hlawby/Ratolesti a wětwe wysoké a sirocce rozložené: Last k Gesenu podobný/ kterýž vžsij/od spoddu aneb na heberl pohlawy, wssickni sstihawý/ wssy na hlaubě a mocne sspicce/sedm aneb osm pálů pohlé. Kwěl má hrozowatý, bělý/ktery sstro dwy sprchne, wyskytugy se ta Gablicka z gedné strany hledé barwy/z druhé obyčegně se edsi na Podzym dozrawagi/a tehdáž se trhagi. a swrstugi w Otrpkách swázaná/ aneb na Slámu a na Seno se rozkládagi/ aby wmuličcka gako Nesspule: Sye ginác nemohau se gistí. pro swau ostrost a trpkost. Dřewo gest twrdé, kyssté a tuhé/ k dělánj Stolků přihodné/ a prawij na Bássně. Kůry gest drobet drssaté. hledé žlutosti/ kořen tmawého. tlusšího, tuwdého a hlaubokého.

Planá Wosskeruše gest též dwogi: Gedna kterážto wlastně Planá slowe: druhá Chochoslatá. Plinius gmenuge Torminalem, Quia tormindus ventris medetur.

* Kterým některý wěcný Lékaři ginau gessté přirownagi/ totiž tu, kterauž ginj Arian Theophrasto nazywagi. Wewlassich, protože dřewo to sirannć twrdé gest. gmenugi ta Wosskeruši Metullo. Obogi hognost rostc w Lesich Německych y Czeskych. *

Planá Wosskeruše nic se nedělj od Zahradny/ leč samým Owocem/ kterež zbarwa se ohněm wytahý/a gest barwy červené, podobné gako Hlohyně/ chuti od domácy do konce rozdylné. Chowagi ty Gahody Ptáčnjcy přes celau Zymu, pro čižbu. Nebo Kwiczały a Drozdi, y ginj některj Ptácy, welmi gc lubugi: my Czechowé tykáme gim Rzežabary.

II. Pho-

(Wallachians) and their animals moved northwards and colonised the Eastern and Western Carpathians during the first centuries of the second millenium. Vernacular renderings of the mountain-ash in Ukraine (*skóruch, skorušina*), northern Slovakia (*skoruša, skorušina, skorušie, skorucha, škorucha*), and in the proximity of the Tatra Mountains in Poland (*skorusza, skorus, skorusa, skorusz*) are a monument to the Wallachian colonisation (Barabás, 2011). The names for the wild service and the service tree were also borrowed by Hungarians. They used the Slavonic word for the wild service: *břekyňa – berkenye*. *Házi berkenye* is the designation for the service tree (Benkő et al., 1984).

The second Czech translation of Mattioli's Herbarium from 1596 distinguishes between the mountain-ash ("křežab") and the service tree ("woskeruše") (Mattioli, 1596).

The history of the name "mountain-ash"

When interpreting the name "mountain-ash" (*Sorbus aucuparia*) we discover that different nations use different word roots than their English counterpart. In Celtic languages and German, the mountain-ash is an "ash with berries". In Czech, the rendering even contains "bird" (*jeřáb ptačí*), which implies that the tree's fruit is very attractive for feathered creatures. Also other Slavonic nations distinguished well between the mountain-ash (*křežab*) and the service tree (*voškeruše*) (Barabás, 2011).

A wine press with a screw made of service tree wood from the late 17th century. Chateau de Pommard, France (1, 2013).

II. 6. Service tree and the beginnings of pomology

Research of the service tree's history in the landscape brings unexpected views on the work of our ancestors and their ingeniousness. Charles Etienne makes an assumption in his *Discourse on Fruit Wines* (1577) that the first fruit wine in Europe was made from sorb apples. This is quite likely since the service tree is the only wild tree that produces edible ripe fruit in large amounts. Fruit can be dried for storage, and can last very long. Trees are long-lived and comparably resistant. The first wine presses (for producing sorb apple wine, apple wine, and grape wine) were probably made from service tree wood in France. In documents and historical resources from the Early Middle Ages, *cormé* predominantly denotes a fermented beverage made from sorb apples – unfortunately there is no description of the preparation procedures. As we already pointed out before, *cormier* as a name for the service tree comes from the Celtic word *curmi*, which generally denoted a fermented beverage, and included even cereal beer (Moinet, 2009). It was common practice in the Middle Ages to find forest gardens (*vadkert*) where fruit trees – including service trees – were grown intensively (Csőre, 1980). Hungarian researchers (Rapaics, 1940; Nyári, 2010) came to interesting conclusions when analysing service trees in the Tokay Hills. They claimed that service trees growing in this agricultural area, which is about several hundred years old, were largely left as reserved trees when transforming forests into orchards and gardens. Even researchers from Baden-Württemberg, Germany, drew the same conclusion (Gräter, 1997). Replanting service tree seedlings or suckers, sporadically found in forests, into gardens and vineyards was a very old method. Slovak Protestant priest and botanist J. Ľ. Holuby described this way of obtaining seedlings as usual in the entire Hungary at that time (Holuby, 1888). This traditional method was also confirmed by contemporaries from Maršov and Hroznová Lhota during an inventory of service trees in Moravian Slovakia (Hrdoušek et al., 2003). Nyári (2010) conducted consanguinity research among 196 service trees, especially in the regions of Danazug and Zemplén in present-day Hungary. He discovered great intra-species diversity of the service tree, which supports his theory that large-fruited service trees were propagated by pomologists as early as in the Middle Ages, especially by grafting on wild service trees. Therefore it seems that service trees had their share in the beginnings of pomology in Western and Central Europe.

A tree on the hillside of former orchards under the Výzkum hill in Hroznová Lhota, Czech Republic (2, 2009).

Repro-photo: A representation of the service tree in the Czech Pomological Atlas (Kutina, 1991).

III. Service tree – description of the species

Sorbus domestica *(Linnaeus 1753 Sp. Pl. 1: 477, 1753). Sorbum* (*Sorbus*) as a name for this tree was probably first used by Marcus Porcius Cato Censorius (234–149 BC) in *De re rustica* (Kausch, 2000), and the earliest mention of the generic name *domestica* can be found in the works of Italian masters Aldrovandi (1553) and Mattioli (1563). **Synonyms:** *Pyrussorbus* (Gaertn. 1790: Fruct. Sem. Pl. 2: 45.), *Pyrusdomestica* (L. 1791: Sm. in Sowerby Engl. Bot. 5:), *Pyrenia sorbus* (Clairv. 1811: Man. Herb. 162), *Cormus domestica* (L. Spach 1834: Nat. Vég. Spach 2: 97.), *Prunus sorbus* (P. Gaertn., B. Mey. & Scherb. 1800), *Mespilus domestica* (L. All. Fl. Pedem. 1785. ii. 142.), *Malus sorbus* (Borkh 1798 Arch. Bot. Leipzig 1(3): 89.), *Crataegus austera* (Salisb. 1796: Prodr. Stirp. Chap. Allerton 357).

Czech names: *oškeruše* (Černý, 1517), *voškeruše* (Hájek, 1562, 1598; Rohn, 1764; Thám, 1818), *voškeruše samice* – generic names *domácí* or *zahradní* (Mattioli, 1596), *řeřabina oškeruše* (Presl, 1819), *jeřáb oskeruch* (Klika, 1846, 1868), *řeřabina domácí* (Opiz, 1852), *woskeruše* (Sloboda, 1852; Čelakovský, 1879; Hynek, 1899), *oskeruše* or *oskeruch* (Polívka, 1904); *jeřáb oskeruše* (Dostál, 1950; Kubát, 2002), *oskeruše domácí* (Tetera, 2006).

Slovak names: *oskeruša* (Reuss, 1853), *oskoruša domáca* (Dostál, 1950), *jarabina oskorušová* (Marhold-Hindák, 1998).

Czech and Slovak popular names: *oskoruša* (Moravian Slovakia), *oškoruša* (Moravské Kopanice), *rozkoruša* (Napajedla), *ozgoruša* (Moravian Wallachian), *voskeruše*, *oškeruše*, *voserušky* (the Litoměřice region), *brek domácí*, *brekyňa*, *oškohrušky*, *oskoruch* (Slovakia).

European names: *oskoruša* (Croatia), skorš (Slovenia), *skoruša* (Bulgaria), *scoruş* (Romania), hazy berkenye (Hungary), *Speierling* (Austria, Germany), *cormier*, *sorbier* (France), *service tree*, *sorb berry* (Britain), *sorbo* (Italy), *serbal común* (Spain), *bahce uvezi* (Turkey), *sourvia* (Greece), *рябина домашняя*, *рябина крупноплодная* (Ukraine, Russia). Only Scandinavian countries do not have their own designations for the service tree.

The service tree in the forest canopy under the Kobyla hill (580 m) in the White Carpathians in Moravia (2, 2009).

III. 1. Basic data on the species

The service tree (*Sorbus domestica*) is a massive and landscapewise decorative tree from the rose family (*Rosaceae*). Free-growing trees have spherical or broadly oval treetops with massive fanned-out branches, and their height reaches 15–20 m. Trees in the forest canopy can grow up to 35 m (Paganová et Bakay, 2010), their treetops tend to be vertically oval, skeletal branches are horizontal, upward-arching, and densely branched (Kausch, 2000). Thanks to the shape of its treetop and bark, the service tree resembles its cognate wild service (*Sorbus torminalis*). However, it can also occur in the form of a shrub about 3–5 m tall, especially on rocky sites, dry Mediterranean area, and in biotopes exposed to grazing,

Free-growing service tree in Kněždub at the foot of the White Carpathians (1, 2008)

A service tree in an open beech-oak forest in Switzerland (Rudow, 2010).

The front and back sides of a young service tree leaf (2, 2012)

harsh weather conditions, and salinisation of the seaside. This broadleaved deciduous tree grows in Europe from Spain up to Turkey and Crimea, and reaches up to Leipzig in Germany and Cardiff in Britain. It does not create any continuous vegetation in the area of its distribution. It is dispersed in forests and open landscape, and often grows near human settlements. The density of service tree distribution in forests is mostly very low, reaching approximately 20–120 trees per 1,000 ha of relevant forests. These are sparse thermophilic oak forests or scree woodlands, which are currently considered rare biotopes (Switzerland – Kamm et al.,2009;Czech Republic–personal utterance, M. Benedíková, 2009; F. Tupý, 2013; Hungary – personal utterance, B. Kiss, 2013).

The scarceness of the species in oak and beech altitudinal zones where the service tree can potentially grow is suggested by research from south-eastern Moravia where 30 million trees can be apportioned to approximately 300 service trees, i.e. 10 service trees to 1 million trees (Baňařová, 2007).

III. 2. Morphology of the species

Bark of young service trees is smooth, grey-brown, and has round lenticels*. Older trees' bark (5–10 years) starts to grow coarse and cleaves from the bottom. The bark of mature trees is grey-brown or red-brown, with frequent clefts. It can peel off spontaneously in longitudinal right-angled sheets. Service tree wood is compact, has rich texture (especially with older specimens) and dull ochre or reddish colour. Growth rings are dense and hardly distinguishable; distinguishing sapwood from heartwood is possible only with new wood. Because of its hardness it is quite difficult to hew. Tap roots are strong, significantly deep and branched, and adapted to be able to intergrow into watery bottom layers of dry locations in which the tree grows. Side roots are sometimes covered in noticeable white stripes (Amann, 1954). The plant creates one to four main roots that are strongly positively geotropic (Kausch, 2000; Hrdoušek et al., 2003). In an optimal soil profile they can grow 0.5 m to 0.6 m deep during the first year (Uherková, 2013). **Buds** are ovate, green-brown, brown or brown-red, glabrous, and sticky. Unlike the *Malus* and *Pyrus* genera, the extension growth of shoots is simultaneous with leaves (Paganová et Bakay, 2010).

*__Lenticels__ – slightly rising lens-like structures on young bark, shoots, and fruits.

Buds of three Sorbus species – service tree, wild service, mountain-ash (1, 2010).

Leaves are alternate, odd-pinnate, 13–25 cm long, with 6 to 10 pairs of folioles; individual folioles are 3–6 cm long and 1.1–2 cm wide. The upper two thirds of the foliole margin are serrate, the bottom third is entire. The top side is dark green and glabrous; the back side is grey-green and wooly. Unlike leaves of the mountain-ash, service tree leaves are less pointed and do not have reddish leaf venation (Čížková, 1997). During September, leaves become yellow, orange or red, turning brown and falling off in the middle of October. Young plants shed their leaves sooner than older ones. In seedlings, the first assimilatory leaves are partly connate and may not be hairy. That is why they can be confused with the mountain-ash. Stipules are an appropriate determination sign (see Chapter VII. Service tree – propagation and plantation).

Colouring of autumn leaves in south-eastern Moravia, Czech Republic (2, 1, 2012).

Blossoms are usually white, scarcely pink, and fragrant. They are mostly nectariferous. Inflorescences are about 6–10 cm wide, arranged into corymbous panicles of about 60–90 blossoms. Blossoms are prone to drying; usually 4–10, rarely 15–20 of them remain and turn into fruits. The service tree is in bloom at the beginning of May, exceptionally in late April, and the blossoms last only 10 to 14 days. It is a monoecious woody plant. Self-pollination occurs in isolate specimens, see Chapter IV. Service tree – system and genetics of the species (Žlebčík, 1999; Chloupek, 2000).

Floral buds in the extension stage of shoot growth; pink floral buds from Viterbo, Italy; a service tree inflorescence in Slovakia (Bačíková, 1, 2012).

Fruits, called sorb apples in line with the *Sorbus* genus, is the largest fruit within the genus in the world. The size of a sorb apple is about 2.5 cm on average, and its weight ranges approximately between 8 g to 10 g. Trees in the open landscape usually have larger fruit than trees in forests. Sorb apples of cultivars in Germany, Southern Europe, and Crimea are up to 5 cm in diameter and can weigh over 30 g (Kausch, 2000; Bignami et Imazio, 2009). Each piece of fruit usually contains 1–2, scarcely up to 6 seeds (Paganova et Bakay, 2010). It is brown or brown-black, approximately 3 mm wide, about 1.5 mm thick, and around 5 mm long.

Cross sections of apple-shaped and pear-shaped sorb apples from south-eastern Moravia (1, 2011).

A sorb apple from Turkey: 4.2 cm in diameter, with noticeable lenticels (2, 2010).

Sorb apples are pomaceous, apple-shaped (*pomifera*) (Hayne) or pear-shaped (*pyriformis*) (Hayne), with a range of transition forms (Tamaro, 1915). The colour of fruit on trees changes from basic green through green-yellow to yellow-orange with pink, red or red-purple cheeks on the sunny side. Lenticels on top of pomes are mostly russet red.Due to the high content of tannin and acids, sorb apples mostly cannot be consumed directly from the tree but need to ripen first. They gradually fall and mature on the ground in most cases: they soften and change their colour from yellow-red to ochre-russet or cinnamon-brown, with light lenticels. Ripe sorb apples are entirely soft and have light ochre pulp. They ripen from the middle of August until the middle of November (Bignami et Imazio, 1998; Hrdoušek et al., 2003). Fruit of trees in one location can ripen at different times, and the interval between two maturation times can frequently reach up to several weeks. Fruit maturation on trees can last as long as a month. Sorb apples of solitary trees ripen as firstly, forest tree maturation occurs later. Sorb apples that fall off trees practically do not rot because of the high content of organic acids and tannin – they rather dry up. Mature trees of 50 years and above give 200–500 kg, sometimes as much as 1,000 kg of fruit in a seed year. In Southern Europe and Crimea, the yield of grafted 50-year-old trees is claimed to amount to 50–200 kg. Sorb apples are picked either by collecting them from the ground or by shaking them down. Shaken-down unripe green fruit withers and often does not ripen anymore. The service tree is a long-lived fruit tree, and therefore its full maturity, i.e. the seed year, in large trees above 100 years of age occurs once every 2–3 years. Sometimes only a part of the treetop gives fruit in continuous years, or the whole tree yields few of them. Sometimes the tree does not give fruit at all, which is mostly caused by May frost or heavy rain during blossoming. Fertility is also lowered by infestation with pathogens, chiefly scab (*Venturia inaequalis*), which causes bad ripening and premature shedding of leaves and fruit (Bignami et Imazio, 2000a; Kausch, 2000). For more information please refer to Chapter IX. 1. – service tree diseases. Trees in Southern Europe give fruit relatively regularly.

The more northward the trees appear, the more their fertility differs in individual years: it can range considerably – from 0.1 to 1.5 tons of fruit (Bignami et Imazio, 1998; Hrdoušek et al., 2003). Service trees grown artificially from seeds begin to give fruit at 7–12 years of age. Grafted plants yield at 2–4 years of age from grafting; however, these trees are not as massive and long-lived. A thirty-year-old non-grafted seedling yields approx. 40–100 kg of fruit in Central Europe. In Serbia, non-grafted trees give fruit mostly after 15–20 or even more years. Fifty- to hundred-year-old trees yield 20–200 kg of fruit (Drvodelić, 2009; Miletić et Paunović, 2012). In southern Italy, trees are smaller – they reach 7 m at the most, and give 100–400 kg of fruit (Bignami et Imazio, 2000a). Out-crossing is necessary for good harvest. Fruit produced by self-pollination is lesser and occurs in smaller amounts.

Six-year-old fruit-bearing grafted plant in Jenčice, Czech Republic (2, 2012).

Unripe sorb apples; colours of ripe sorb apples; gradual ripening of sorb apples on a service tree; naturally dried-up sorb apples in south-eastern Moravia (1, 2012).

III. 3. Service tree variability

Fruit

Fruit of service trees – sorb apples – is characterized by high variability*:they usually measure 1.5–5 cm in diameter, the weight of one pome ranges between 5 g and 40 g. The weight of fruit in Turkey, Serbia, and Crimea can reach up to 25 g (Termentzi et al., 2006; Miletić et Paunović, 2012, personal utterance Mezhenskyj, 2012). The largest weight documented in Moravia was 27 g, the Panele variety in Italy weighed up to 40 g (Bignami et Imazio, 2009), the biggest sorb apples in Veitshoechheim, Germany, weighed up to 49 g and their dimensions were 4.5 cm x 5.4 cm (Kausch, 2000). Sorb apples sampled in South Moravia weighed 5–12 g, sometimes even 15 g (Čížková et al., 1999; Hrdoušek et al., 2003; Benedíková, 2009). The average weight of sorb apples from the White Carpathians was 11 g (Špišek, 2009). Sorb apples 4 g to 21.3 g (Miko et Gažo, 2004), while fruit from south-eastern Slovakia was lighter: 4.9–18.6 g (Brindza et al., 2009). According to Kausch (2000), the weight of sorb apples in Germany ranges between 5 g and 20 g. In Austria, it was discovered in a collection of 120 trees that most sorb apples were pear-shaped and their weight ranged between 8 g and 17.8 g, which is 11.6 g on average (Kainits et al., 2000). Researches in Croatia state that the average weight of sorb apples ranges from 3.75 g to 17.1 g (Drvodelić et al., 2009). In the vicinity of Banja Luka, Serbia, it was recorded that the weight of sorb apples was from 8.75 g to 10.45 g, blooming period lasted from the 5th of May to the 5th of June, and maturation period from the 1st to the 20th of September (Stefanović et al., 2012). In Timočka Krajina (the Timacus frontier), eastern Serbia, fruit of 200 trees was observed. The following sorb apples were distinguished: small, weighing from 7.5 g to 10 g (52.2 % of trees); medium and large, weighing 10–20 g (41 % of trees); and very large, weighing 20 g (6 % of trees). The weight of fruit from the last group was 21.5–25.6 g (Miletić et Paunović, 2012).Two basic types of service trees can be distinguished according to the size, weight, and shape of sorb apples: wild (growing in forests) and cultivated (Hrdoušek et al., 2003; Uherková, 2013). Forest service trees usually have small fruit that is spherical or elongated-spherical, green with no yellow tint but with dull red cheeks with a diameter of 1.5 cm and weight up to 7 g. Sorb apple shapes from cultivated service trees range from spherical to elongated-pear-shaped, mainly with yellow or red cheeks. The diameter of most sorb fruits from cultivated service trees

Sorb apples from a forest in Germany (H. Fischer, 2012).

Fruit size variability in the crop of one tree, Piešťany, Slovakia (L. Zubák, 2010).

*Variability – biological diversity of plant and animal forms.

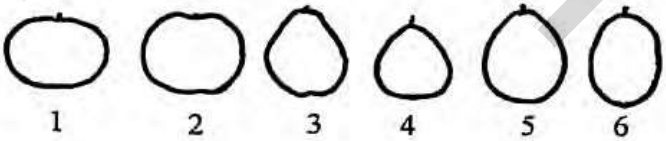
exceeds 1.5 cm. Trees with fruit whose diameter is mostly 3 cm and weight 10 g can be regarded large-fruited. It was as early as Kárpati (in Májovský, 1992) who distinguished between wild service trees with sorb apples 1.5–2 cm large, and considered specimens with sorb apples being 3 cm in diameter as cultivated. Végvári (2000) puts forward that fruit from trees in the open landscape are, on average, larger than 1.5 cm, which is a result of cultural selection. This basic classification of sorb apples has been confirmed by historical data as well. In his *Treatise on Fruit Trees* (1765), Duhamel du Monceau describes two types of service tree: *sativa* for grafting, and *silvestris*, which is not intended for this propagation method (Moinet, 2009).A number of existing studies about the service tree advert to shape variability of its fruit (Bignami et Imazio, 1998; Fialová, 1998; Čížková et al., 1999; Kausch, 2000; Miko et Gažo, 2004; Tetera, 2006; 2009; Brindza, 2008; Špišek, 2009).

Rare pear-droplet-shaped sorb apples from the Zala region in Hungary (1, 2013).

In Slovakia, Benčať (1995) distinguishes only two types of sorb apples according to their shape: pear-shaped and spherical. The following differentiation of sorb apples was made for the vicinity of Frankfurt am Mein, Germany: pear-shaped (78 %), transitional-shaped (17 %), and apple-shaped (5 %) (Koch in Kausch, 2000). In contrast, a study of 200 trees in Timočka Krajina, eastern Serbia, reports the occurrence of 62.5 % of apple-shaped and 37.5 % of pear-shaped sorb apples (Miletić et Paunović, 2012).The image below shows the range of fruit shape variability we can differentiate probably in all regions of service tree occurrence. A pilot study of sorb apple shape variability on twenty selected service trees was carried out in southern Italy in 1998. As a result, the study presented 6 types of pomes: oblate, spherical, pear-shaped, conical, ovate, and elliptic. The prevailing type was conical, and the ovate and pear-shaped types were amply represented as well (Bignami et Imazio, 2008).

Fruit shapes:

1. *oblate (planispherical)*
2. *spherical*
3. *pear-shaped*
4. *conical*
5. *ovate*
6. *elliptic*



Shape classification of sorb apples (Bignami, 1998).

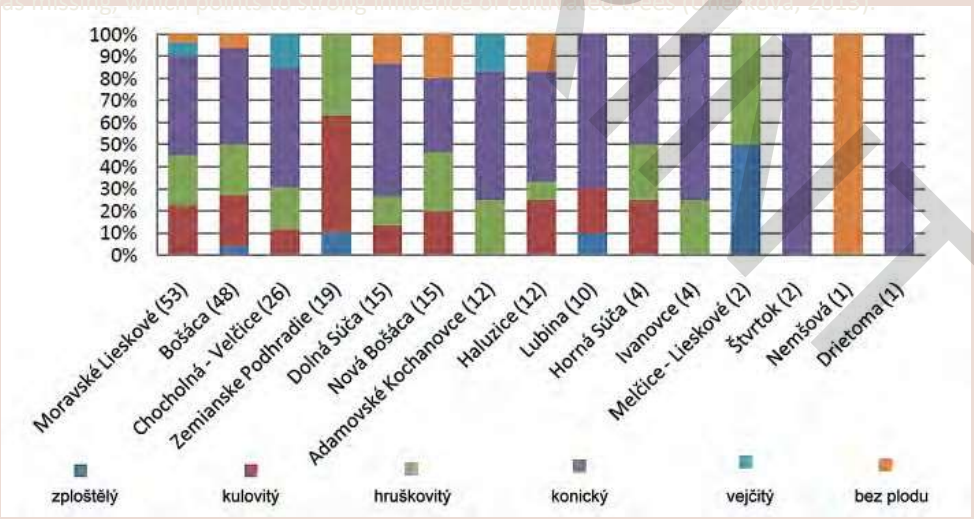
The differentiation into 6 types was also confirmed by other European studies, which point to great fruit shape variability. The representation of each type differs from region to region – this is caused not only by actual variability but also by subjective evaluation

of the research author. The 6-type classification was confirmed by Miko (2002) who studied a population of 97 service trees in 6 Slovak regions where the majority of sorb apples was represented by the ovate (56.7 %) and conical (23.4 %) shapes. However, the most abundant shape (49 %) from among 221 trees observed in the White Carpathians was conical (Uherková, 2013). On the Moravian side of the White Carpathians, pear-shaped fruit was documented in 50 % of 158 surveyed fertile trees (Špíšek, 2009). The box below gives more information on this issue.

Fruit variability in Moravian Slovakia, Czech Republic (1, 2011).

Fruit shapes in the White Carpathians

The research of fruit shape variability was targeted at the Moravian part of the White Carpathians in 2008; 180 trees were discovered and in 158 of them it was managed to sample their fruits. Sorb apples were categorised into 6 types of shape. The proportion of individual types of sorb apples in observed localities of the White Carpathians was as follows: pear-shaped – 49.9 %, spherical – 20.3 %, conical – 19 %, ovate – 6.4 %, elliptic – 2.5 %, and oblate 1.9 % (Špíšek, 2009). During the work in the Slovak part of the White Carpathians, Uherková (2013) distinguished 5 types of sorb apples in a sample of 221 trees in which no elliptic shape was discovered. The prevalent type was conical (48 %), followed by considerably abundant spherical and pear-shaped types. It is interesting how sorb apples differ in shape when multiple town cadastres are compared. In the cadastre of Zemanské Podhradie, the spherical shape prevailed while the conical was missing, which points to strong influence of cultivated trees (Uherková, 2013).



The representation of fruit types in individual cadastres in the Slovak part of the White Carpathians (Uherková, 2013). Note: Numbers in brackets indicate the number of trees.

Sorb apple variability in Central Bohemian Uplands (České středohoří), Czech Republic (1, 2008).

Sorb apple variability in the vicinity of Vesuvius near Naples, Italy (1, 2009).

Sorb apple variability in the Zala region, Hungary (1, 2013).

The variability of sorb apples in Southern Europe is given by the long-standing tradition of tree cultivation, which is however by far not as rich as in Central Europe (Kausch, 2000). Morphological studies from Hungary proved interconnection between the shape and colour of sorb apples: fruits with various colours (yellow, red, wine red, brown) differed from one another by their shape (Végvári, 2000). Differences in fruit maturation in trees with different shapes of fruit are also significant (Continis, 1988). The shape of the stem and the formation of a calyx-end depression are yet other areas where significant sorb apple variability is manifested. There are types with a sunken or ascending stem with a callus, with a medium-deep calyx-end depression, with calyx remnants, or broad and raised calyx remnants in the calyx-end depression.

We can also observe sorb apple variability on one service tree (Kausch, 2000). Research in Nieder-Mörlen, Austria, showed that ripe fruit from one tree can differ in its weight up to 8.5 times (2–17 g) – see Fig. (Werner et Mauer, 2007). Great variability of size (1.2–3.5 cm), weight (4–15 g), and fruit shape (three types according to the scale by Bignami et Imazio, 1998) can also be observed in individual trees

Weight variability of sorb apples (2–17 g) of a service tree in Austria. Compare: the diameter of a 1 euro coin is 23 mm (5, 2007).

at the border of Moravia and Slovakia. Every tree therefore creates its own fruit variability, which is dependent on the particular year's weather and health condition of the tree. Nevertheless, trees maintain a specific shape with most of their fruit. Like with other fruit trees, the service tree can yield smaller fruit in periods of big drought or excessive crop.

Sorb apples can be distinguished by various colour forms as well. In Moravia, the prevalent types are conical and pear-shaped with red cheeks. Some service trees growing above Bzenec na Moravě have brightly yellow sorb apples with no cheeks. Even planispherical sorb apples with a tint of violet can be found in the vicinity of Strážnice. Dark red and bronze-skinned fruit was found when mapping

Size variability (from 1.2 cm to 3.5 cm) in the crop of a service tree in Kněždub in south-eastern Moravia (1, 2007).

Hungary (Végvári, 2000). Apart from common fruit types, bronze-skinned fruit with no cheeks and fruit with rough coriaceous skin were recorded in the vicinity of the German town of Kronberg (near Frankfurt am Mein). Fruit with pink-tinted skin has been described in France (Moinet, 2009). Sorb apples differ from one another in their taste, smell, and skin thickness in a relatively significant manner. When comparing the above-mentioned characteristics of sorb apples from individual regions of Europe, we discover that many types recur or resemble one another, and therefore the service tree can be assessed pomologically (see Chapter XII. Service tree – introduction into pomology of the species). In comparison with wild apple and pear trees (or wild apple and pear trees that were originally cultivated) that reach similar sizes as wild service trees, it would be interesting to ask what size of sorb apples can be achieved by purposeful cultivation.

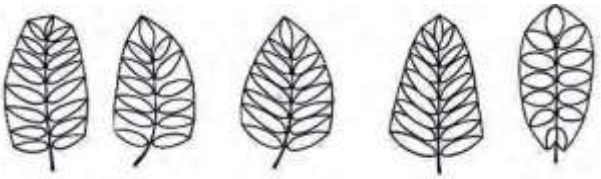
Fruits of wild apple trees, pear trees, and service trees at the border of Moravia and Slovakia (1, 2010).

Leaves

Shape variability of service tree leaves was studied in Slovakia. Leaves were divided into elongated, elliptic, broadly elliptic, ovate, and obovate categories. Over 60 % of the observed leaves had an elongated shape (Brindza et al., 2009).

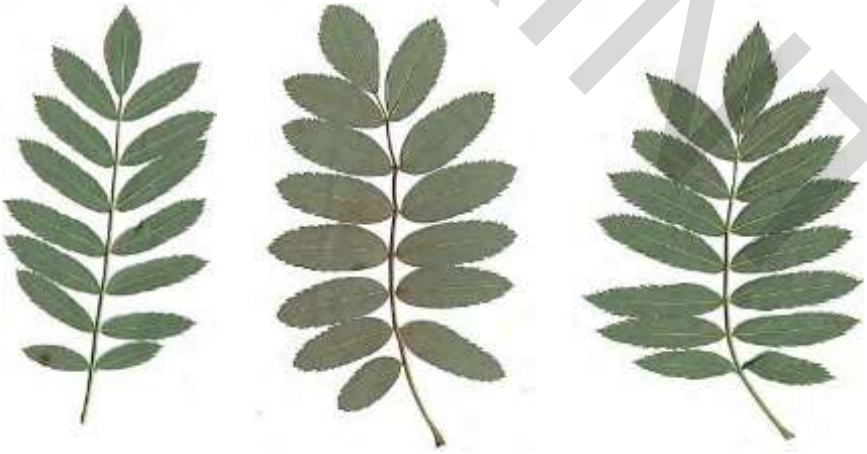
Leaf shapes:

- *elongated*
- *elliptic*
- *broadly elliptic*
- *ovate*
- *obovate*



Leaf shape variability classification (Brindza et al., 2009).

In the Balkan Peninsula, service tree leaf variability was also studied in altogether three populations located in the region of today's Bosnia and Herzegovina, Slovenia, and Serbia. From each population, 30 leaves of 30 trees were observed. Geometric morphometrics, using the parameters of the middle pair of folioles as comparison, was employed for the purposes of the comparative study. It was discovered that leaves from the region of Bosnia and Herzegovina exhibited greater number of jags than leaves from the remaining two localities. In addition, it was observed that leaves from trees growing in the Serbian localities were more elongated, while leaves from Slovenia were characterised by the biggest average size. In the observed localities, the results of the study proved natural phenotypic variability within and even among populations. It is interesting to note that the greatest intra-population variability was documented in Bosnia and Herzegovina (Brus et al., 2011).



Service tree leaf variability – obovate, elongated, and broadly elliptic shapes (2, 2013).

Bark

Diversity in bark formation can be distinguished only when trees are mature – roughly after 20 years of age. Variability corresponds not only to biotope conditions but also to the type of tree (personal utterance, H. Fischer, 2012). Bark can be distinguished according to different roughness or its arrangement that corresponds to upward or spiral growth of wood. Direct, right-handed, and left-handed growth types can be distinguished according to its arrangement. The most frequent one is the direct growth type.

Non-fissured bark of a young tree (10 years) with noticeable lenticels, Horka u Brna, Czech Republic (1, 2010).

The bark of an approximately 300-year-old tree with furrowed, checkered surface, Strážnice, Moravia (1, 2009).

Right-handed structures on the bark, Kronberg, Germany (H. Fischer, 2012).

Left-handed trunk of Tomeček's service tree, Tvarožná Lhota, south-eastern Moravia (2, 2011).

Scaled bark

Longitudinal bark

Furrowed, tesselated bark (Čížková, 1999)

Bark of service trees in the White Carpathians

Three types of service tree bark roughness were observed in the protected landscape area of the White Carpathians. Their representation in the landscape is as follows: imbricately shedding bark 15 %; longitudinally shedding bark 43.3 %; furrowed, tesselated bark 41.7 % (Špišek, 2009).

Seeds

Seeds can be categorised according to their shape into 3 categories: droplet-shaped, semi-circular, and irregular (Brindza et al., 2009). The average weight of thousand seeds (WTS) of the service tree according to the CSN 482111 standard, revised in October 1997, is 35 g (Benedíková, 2009). However, WTS measured in seeds sampled in South Moravia ranged from 15.73 g to 34.62 g (Čížková et al., 1999; Benedíková, 2009). The total average WTS in the White Carpathians was 21.75 g (Špišek, 2011); WTS documented by Drobná et Paganová (2010) was 27.16–35.82 g where solely trees growing on the site of Kosihovice corresponded to the CSN 482111 standard. The WTS in south-eastern Slovakia ranged between 12.5 g and 34.9 g (Miko et Gažo, 2004); in Germany, the value ranged between 20 g and 22 g (Kausch, 2000). Kausch states that the WTS of seeds from Naples, Italy, was 44.72 g. Greater weight of seeds in Southern Europe can be caused by better vegetation conditions on local sites or by the fact that the species avoids the competition of others in regions with less precipitation, e.g. the beech (Hemery et al., 2009), which is why it can afford to invest more into its progeny.

Seed shapes:

- *droplet-shaped*
- *semi-circular*
- *irregular*

Service tree seed shape variability classification (Brindza et al., 2009), adapted.

The number of seeds in a pome can depend on its size. The isolation of the tree is also significant. This restricts cross-pollination – mutual pollination between different specimens – and therefore a higher number of seeds in each fruit as well (Paganová, 2010). The maximum number of seeds can be 10 (Bignami et Imazio, 2008). When sampling seeds in the White Carpathians, no correlation between the size of fruit and the number of seeds was observed; 5 seeds at the most were found in each piece of fruit. Sorb apples of some service trees were big but contained no seeds at all (Špišek, 2009). In Croatia, sorb apples with the average number of seeds ranging from 1.8 g to 3.5 g statistically showed significant positive correlation between the weight of fruit, the weight of seeds, and the number of seeds (Drvodelić et al., 2009). The greatest sorb apples in Crimea contained the highest number (4–5) of seeds too (Černobaj, 2010). Many authors discovered positive correlation between the weight of thousand seeds (WTS) and their germinability in natural conditions: the higher the WTS, the higher the germinability of seeds. Service tree seed germinability is extensively variable (7–93 %) depending on the genotype (Miko et Gažo, 2004; Špišek, 2009; Drobná et Paganová, 2010). For more information please refer to Chapter VII. Service tree – propagation and plantation.

Content substances in service tree seeds were studied by Májovský (1992), Pagan et Paganová (2000), Brindza et al. (2009). It was discovered that seeds contained 2 % of sacharose, 1.83 % of fructose, and 0.5 % of glucose (Brindza et al., 2009). Proteins in seeds were represented in a large amount (32.9 g/kg) in comparison to proteins in fruit (0.44–0.65 g/kg). Quite interesting figures are the content of fats in seeds (20.5 %) and a high level of pentadecanoic acid (15.6 %) (Brindza et al. 2009).

Solitary trees in the landscape play an important role in pollen transmission and consequently in genetic diversity. They serve as so-called stepping stones (see the bottom of p. 50). Lekavý's service tree in Josefov in south-eastern Moravia (1, 2012).*

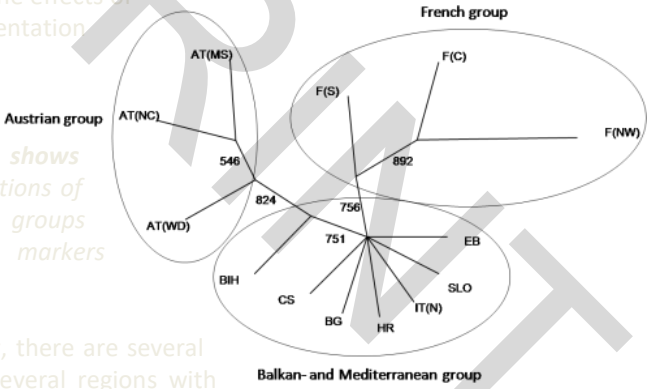
IV. Service tree – species system and species genetics

IV. 1. The service tree and related species

The *Sorbus* genus represents one of the most complex groups of European flora. This complexity stems from the fact that, apart from a prevalent normal sexual reproduction, the species of this genus have the ability to reproduce asexually via clonal reproduction through seeds, a process called "apomixis." Therefore, the members of the *Sorbus* genus are usually divided into two groups based on their method of reproduction – primary species (which reproduce sexually and are usually diploid*) and derived, or hybridogenous, species (which also reproduce via apomixis and are polyploid*). In Europe, the second group is much more prevalent. The *Sorbus* genus as a whole includes some 150 species in Europe (Kovanda, 1992) and 200 to 250 species in the temperate zones of the Northern hemisphere (depending on a chosen taxonomic approach). At the moment, we are not sure how the individual species are related to one another, but studies point to a significant amount of hybridization (interbreeding between different species) and complicated genetic relationships within the whole *Malinae* subtribe, which includes the *Sorbus* genus (Campbell et al., 2007; Potter et al., 2007; Robertson et al., 2010). In addition, phylogenetic analyses focusing on certain genes and parts of DNA showed that the individual groups within the *Sorbus* genus are not similar to one another. Even Linné noticed the striking morphological divergence of this genus; therefore, he classified some members of the *Sorbus* genus (whitebeam, checker tree, dwarf whitebeam) as members of the *Crataegus* or *Mespilus* genera. In the Czech Republic, the *Sorbus* genus is represented by 5 primary and 19 hybridogenous species (Danihelka et al., 2012; Lepš et al., 2013). Among the primary species are service trees (*S. domestica*), whitebeam (*S. aria*), checker tree or wild service tree (*S. torminalis*), dwarf whitebeam or false medlar (*S. chamaemespilus*), and rowan or mountain-ash (*S. aucuparia*). It has been demonstrated that all these species have a diploid number of chromosomes (2n = 2x = 34) and that they always reproduce sexually (Kovanda, 1992). Service trees, however, are notably different in one respect – unlike the other species, they are never involved in interspecies reproduction, and so they don't produce hybridogenous apomictic species (Nelson-Jones et al., 2002). This can be related to the fact the species is isolated within the *Sorbus* genus (Potter et al., 2007); it might also have to do with the hypothetical evolutionary age of the species (Kárpáti, 1960).

IV. 2. Genetics of the European service tree populations

In Europe, service trees are rare and typically occur in small populations that are located far from one another. At the moment, there is no study that would explore all of the service tree populations, or at least those in Europe. There are, however, studies that focus on specific regions or larger territories and that explain the population characteristics of service trees and might help us in making some general observations. To date, the most comprehensive study included more than 440 samples from 9 European countries (Austria, Switzerland, Slovenia, Bosnia and Herzegovina, Serbia, Croatia, Bulgaria, France, and Italy) that were analysed via 7 nuclear microsatellites and a chloroplast minisatellite (George et al. 2015). This study showed that genetic diversity was unexpectedly high within populations for both marker types. Moreover, there was no evidence of inbreeding. The Italian Peninsula was characterized as a geographic region with comparatively high genetic diversity for both marker types. Overall population differentiation was moderate and it was evident that populations formed three groups in Europe, namely France, Mediterranean/Balkan and Austria. Historic gene flow between two local Austrian populations was high and asymmetric, while recent gene flow seemed to be disrupted. It was concluded that molecular mechanisms such as self-incompatibility and high gene flow distances are responsible for the observed level of genetic diversity as well as for population differentiation. However, human influence could have contributed to the present genetic pattern, especially in the Mediterranean region. The comparison of historic and recent gene flow between two large Austrian populations showed the effects of the progress of habitat fragmentation in eastern Austria.



*Graf: By **UPGMA-dendrogram shows** Clustering of European populations of Sorbus domestica into 3 main groups based on nuclear genetic markers (George et al. 2015).*

Apart from this complex study, there are several smaller ones that deal with several regions with service tree populations. These studies were carried out in Germany, Switzerland, and Hungary; and more recently, the Czech Republic has also taken part in these genetic analyses. The results point to several interesting facts. For instance, the service tree populations in question demonstrate a strong tendency towards cross-fertilization (or "allogamy").

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* **Diploid species** – diploid cells have two homologous copies of each chromosome, one from the father and one from the mother; **polyploid species** – polyploid cells have more than two copies of each chromosome. Polyploidy is common in plants and it can lead to higher yields and increased height.

The "Shipova" (× Sorbopyrus). A viable hybrid of the European pear and the common whitebeam, not of the service beam. (1, 2014)

Even though service trees have hermaphrodite flowers, self-fertilization, or "autogamy," is rare. Probably there is a self-incompatibiltiy system at work similar to the one found in other species in the pear family, though it is not fully functional. Studies have shown that inbred offspring have less vitality, and chlorophyll defectant mutants are common in selfed progeny (i.e. white seedlings, which die after a few days due to inability for photosynthesis; Kamm et al. 2012). Also the number of seeds per fruit is much higher when different pollen donors are available (Bariteau et al. 2006). The Swiss study showed that thanks to insects, fertilization can happen across wider distances – there were cases when the insects travelled12 kilometers. However, this is unusual – typically, pollen travelled 1 or 2 kilometers (Kamm et al., 2009).

Therefore, isolated trees are very important, because they act as stepping stones*. Trees that grow close to one another do not pollinate one another very often; this might be caused by differently timed phenophases* and the fact that they bloom at different times (Paganová et Bakay, 2010). It is clear that autogamy can have negative repercussions. The progeny of autogamy is notable for the high incidence of albinism (i.e. a situation when photosynthesis is blocked, there is little or no chlorophyll, and the seedlings are dying), which was diagnosed in 25 % of the cases (Dagenbach, 2001). However, it remains to be seen whether cross-fertilization, or a tendency towards pollination by non-related plants, is a general trend – Chloupek (2000) says that cases of both inbreeding and autogamy are quite frequent. Another study that was carried out in Hungary found out that tree populations in one location (a hill, a slope, a forest) demonstrate both high genetic variability in each population and high genetic similarity between individual populations across the territory (region, country). This might be caused by the fact that pollen and seeds can, in a natural way, travel long distances, or by the tree populations planted by humans (Nyári, 2010). Rotach (2003) argues that the aforementioned high genetic variability of the service tree populations points to a good adaptability of the species when it maintains low-density populations. However, others think that populations with a lower genetic variability could have occurred naturally (Nyári, 2010). We will discuss the characteristics of individual regional populations in the next chapter.

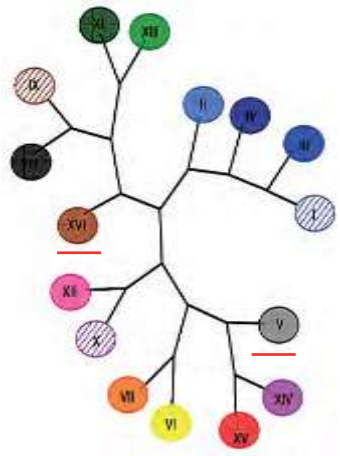
***Heterozygote –** an organism with a genotype (genetic information) that is, in a given part of DNA, represented by two different alleles (Aa) on each chromosome, which shows that it was created by the breeding between two individuals (with AA x aa or Aa alleles).

***Phenophases** – phases in lives of living organisms that depend on their habitats.

***Stepping stone** – a small habitat with just a few individuals located between two isolated populations. These outposts provide resources for both plants and animals crossing long distances, and they also serve as refuges (Tkadlec, 2008).

Hungary

For this study of the populations in Hungary, specifically in Dunazug Mountains (Transdanubian Mountains) and Zemplén Mountains, the researchers employed a method of chloroplast DNA sequencing (cpDNA) (Nyári, 2010), which depends on the resilience of the plastid genome. This method can be used, for instance, to learn where a given population originated and how it is related to other populations, or to discover more about their migration pattern after the Holocene ice age some 12,000 or 10,000 BCE.



An UPGMA diagram showing the relationships between individual haplotypes found in two Hungarian regions (Nyári, 2010).

The sample included 196 trees. There were 16 different haplotypes*, i.e. different maternal lineages (see the illustration). Amongst these haplotypes, just one haplotype (XI, indicated by he green color) was truly frequent (46 %).

This haplotype is prevalent in the Zemplén Mountains region. Interestingly, it was the only haplotype that occurred at the Kácsárd wineyards location. Overall, there were a few other haplotypes that occurred more frequently than others – haplotype III (blue), which occurred in 15 % of the cases, and haplotype V (grey), which occurred in 12 % of the cases. Haplotypes XI, III, V, and XIV were present in both regions (Nyári, 2010). The observed Hungarian populations were mostly of mixed haplotypes. It is interesting to note that a haplotype which is dominant in one region can be a minority in another one. The samples in question demonstrate the importance of zoochory (seed dispersal by animals), because zoochory is one of the key propellers of gene flow*, which allows for a possible colonization (or re-colonization) by a new haplotype. According to the genetic analysis of variance (ANOVA), 67 % of the overall variability can be attributed to intrapopulation variability, 27 % to interpopulation variability, and only 6 % to variability between the two regions, which are 200 kilometers far from one another. There are no metapopulations between the individual locations, so it is impossible to say how much can be attributed to humans and how much happened in a natural way. The Kácsárd wineyards, which belongs to the Tokaj wine region, represent an interesting example of anthropogenic expansion – according to Kárpáti (1942), we know that there was a selective transfer of seedlings from nearby forests. Genetic analyses of this region showed only one haplotype – XI (green). However, the samples from the Zemplén Mountains region, where the trees are also being cultivated, show

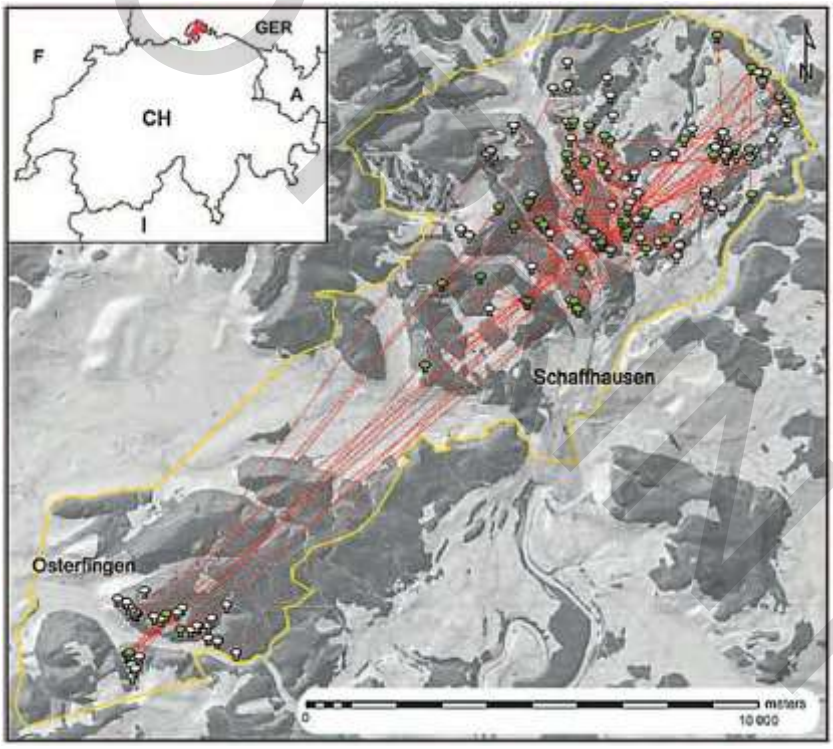
*Haplotype – a group of alleles on a chromosome that are closely related to one another and that usually occur together (there is no recombination).

*Gene flow – transfer of alleles (specific forms of genes) from one population to another. This migration is carried out by migrating organisms (or, specifically, by seeds or pollen). For example, a service tree seed from population A is transferred by a digestive system of a bird to population B. Here, it becomes a tree and achieves sexual maturity. All its alleles (some of which might be unique to population A) can then be incorporated into population B.

greater variability. In fact, the samples taken from private gardens, wineyards and overgrown orchards of the Buda region show amazing variability (Nyári, 2010).

Switzerland

The second major study focusing on gene flow possibilities and spread of service trees took place in the Canton of Schaffhausen, the northernmost canton in Switzerland (Kamm et al., 2009). The study itself represented a culmination of twenty years of research – during this time, the whole region was surveyed in great detail and seeds extracted from various individual trees were incorporated into the seed bank. In this territory, which encompasses roughly 100 square kilometers, service trees are usually found in forest covers with dominant beech trees. The locations of the trees in question were determined via GPS and they are shown in the following map. Overall, there were two distinct forest subpopulations:



Pollen propagation (gene flows) of service trees in the Canton of Schaffhausen in Switzerland (copied from Kamm et al., 2009). The yellow line demarcates the area of study (roughly 100 square kilometers) – all service trees in question were found within this territory. Forested areas are indicated by the dark grey color; the green symbols indicate mother trees. The red lines connect documented parents, and so indicate current gene flows propagated by pollen. The map in the upper left corner indicates the position of the area (red) within Switzerland.

Schaffhausen, with the density of 0.042 individuals per hectare, and Osterfingen, with 0.138 individuals per hectare (see the illustration). The study included 189 trees – researchers extracted their genetic material (leaves) and measured their diameters at breast height. With the help of 9 microsatellites*, they were able to find 62 allels (specific forms of genes).

Current service tree gene flow in the Canton of Schaffhausen in Switzerland. White circles indicate the trees with a rare haplotype of chloroplast DNA, while the empty circles indicate the trees that have a common cpDNA haplotype. The sizes of the circles indicate their DBHs. The arrows show directions of the gene flows (Kamm et al., 2009).

The results show that even in diverse environments and with a low density of service trees in given territories, most adult trees belong to the pollen flow network. Pollen propagation is hindered mainly by provinces, deep valleys and large deforested areas with intensive agricultural soil use. After the first 200 meters of distance, the pollen donors became less important.

The average distance of pollen propagation was 1.2 kilometers (N = 495, number of pollen transfers). Surprisingly, the ratio of pollen donors within 1 to 2 kilometers of distance from mother trees was rather high (33 %). If we were to go farther than 2 kilometers, we would find that 10 % of mother trees were pollinated. Interestingly, there were 13 documented long-distance pollen transfers (which comes up to 1.8 % of trees) between two subpopulations, which are between 12 and 16 kilometers from one another (see the illustration). Even more surprisingly, the seeds where we couldn't discover the source of the pollination came from trees that are close to the Northern border of the region in question. This points to the conclusion that there are at least some adult service trees in the neighbouring country of Germany, even though they were not found there physically as of yet (Kamm et al., 2009).

***Microsatellite –** a tract of repetitive DNA in which certain units ranging between 1 and 6 nucleotides are repeated. This short sequence often occurs numerous times within one microsatellite and forms a string which can have more than 100 bases; these sequences are therefore highly suitable for population genetics studies.

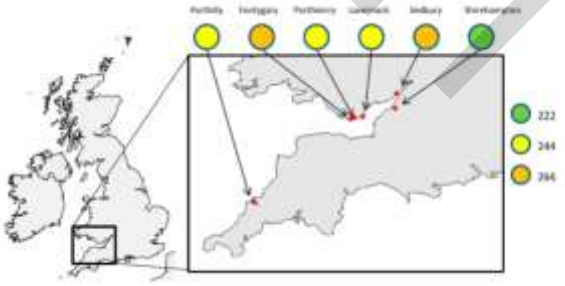
This tree on the "Huy" hill west of Halberstadt (Saxony-Anhalt) belongs to the northernmost known population of service trees (3, 2000).

Germany

There was a similar study carried out in Saxony-Anhalt (Werner et Mauer, 2007), the northermost region where service trees naturally occur (see the illustration). This study employed the isoenzyme comparison method. This method is used to indirectly observe genetic variability on the level of proteins. During the analysis of 7 enzymatic systems, the researchers found 12 distinct loci (exact positions on a chromosome). Furthermore, the population of service trees in Saxony-Anhalt was compared to referential populations in Switzerland, Southeastern Germany and Austria. The results indicate that the genetic variability (diversity) of the populations in Saxony-Anhalt (measured on 14 trees in Thuringia) is lower than in territories in Southern Germany and Austria.

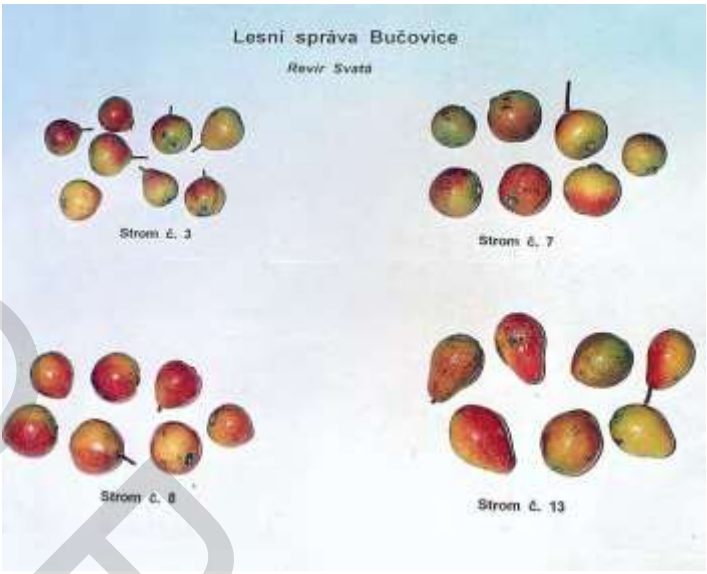
United Kingdom

True Service-tree (*Sorbus domestica* L.) is an extremely rare and only spontaneously occurring tree species in the British Isles. Its populations are characterised by low census size and strong fragmentation. For analyses was collected 31 samples from six different sites across south Wales and south-west England, spanning the whole putative natural occurrence in Britain. Genetic diversity in the entire British population (all six sites) was unexpectedly high. Finally, comparison with a pan-European dataset of S. domestica revealed a close association between British and French populations rather than with populations from the Mediterranean area or Balkan Peninsula (George 2016). The putative native status of S. domestica in the British Isles is Nevertheless, remains critically endangered, because population census size is very low. Since the observed phenotypes, viz. small, wind-stunted and with a pronounced ability to propagate vegetatively, could represent local adaptations to the harsh environmental conditions at the northern distribution limit, we recommend that conservation efforts should include the creation of ex situ seed orchards and the planting of offspring individuals as 'stepping stones' to connect sites genetically (George 2016).



The Czech Republic

Mapping genetic diversity and structure in marginal plant populations is essential for managing their genetic resources. This is particularly important for rare, scattered tree species, such as true service tree. For example, such knowledge allows to design seed sampling for ex-situ and in-situ conservation efforts (selection of populations and spacing among sampled trees) maximizing genetic diversity of future generations.



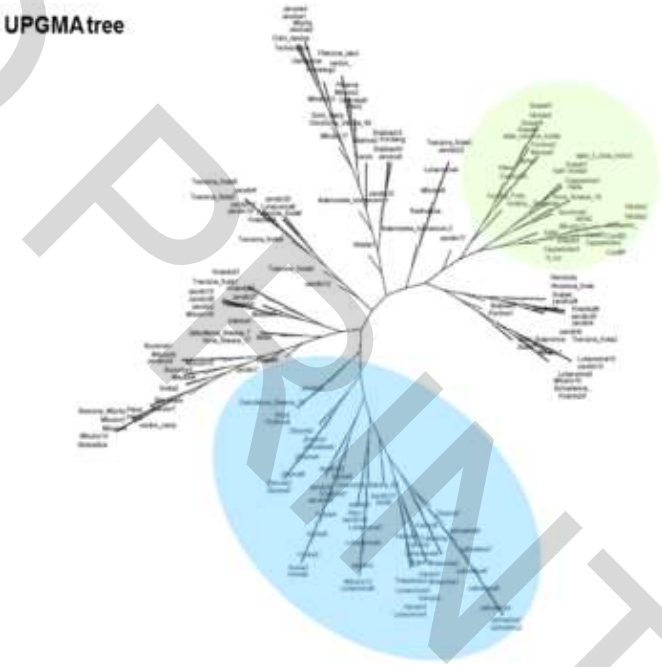
The genetic variability of service trees is also noticeable in the diversity of shapes and sizes of their fruits in the Svatá territory in the Bučovice na Moravě forest management area (M. Benediková, 1999).

Because *Sorbus domestica* has the ability for vegetative reproduction and clonal growth), population genetic surveys of this species should be conducted with careful assessment of the presence of clones, which should be taken it into account in subsequent genetic analyses.

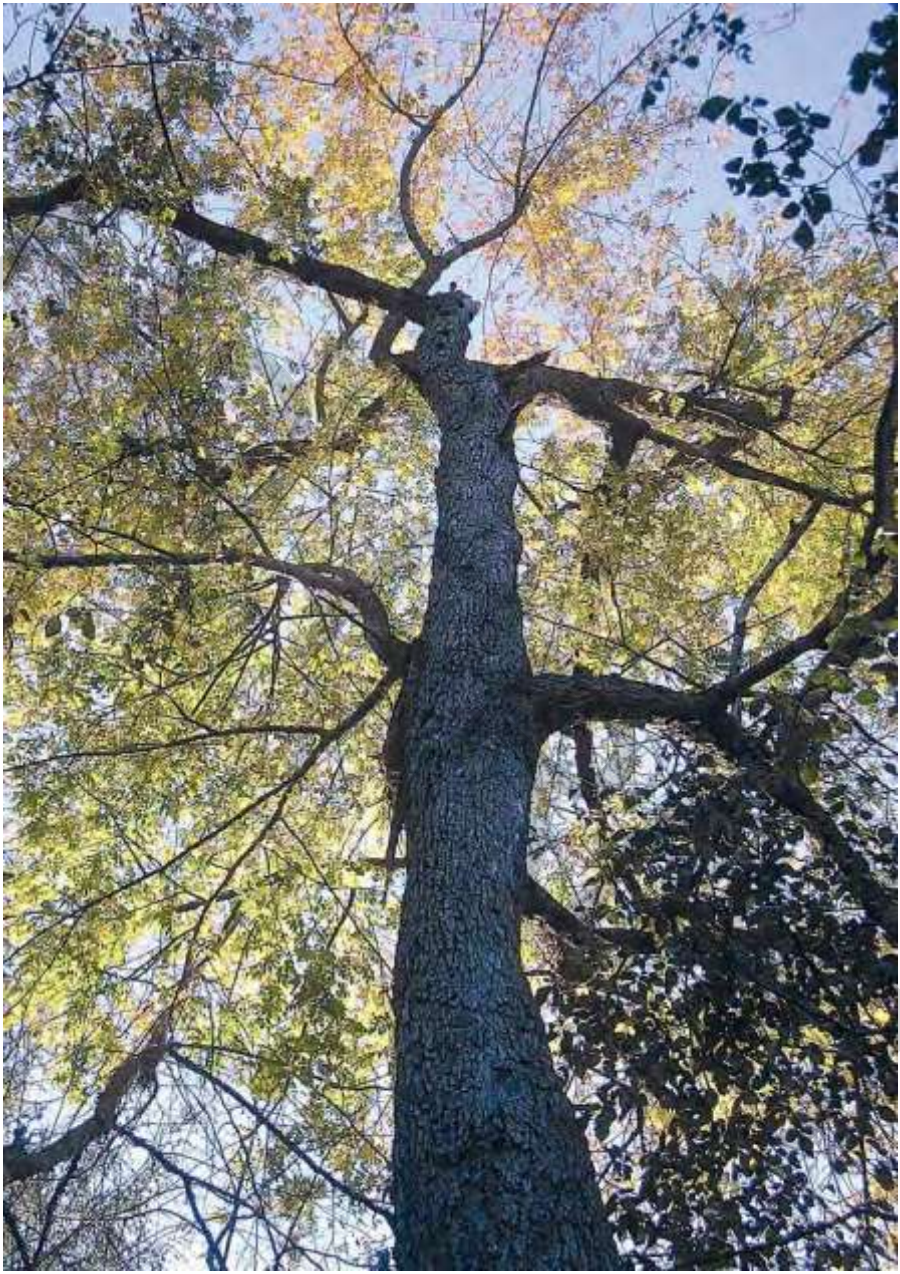
The research regarding the service tree genetic variability within the Czech Republic is still underway and, as of this moment, the results are not final (Špišek in prep.). In the first phase of the project, the study focuses mainly on the White Carpathians region, but researchers are taking samples from other regions as well. At the moment, we have genetic material (leaves) from 197 trees from three different regions. If we were to count only the **White Carpathians landscape** park, we would have genetic material from 82 trees. Most of the samples come from populations located on the slopes of the Žerotín hill and the western slopes of the Šumárník hill. The nuclei of these populations are located 4.2 kilometers from one another. The borders between these populations are somewhat unclear; usually, they consist of individual trees that presumably act as stepping stones (Špišek, 2009). These solitary trees with spherical crowns grow mainly in cultivated landscapes; these landscapes are often abandoned orchars or wineyards. These locations are often in direct contact with populations in Slovakia. The samples also come from the areas of the Ždánice **Forest and Chřiby**. The researchers collected 73 samples from this region, mainly from service trees growing in forests. Local cultivated landscapes typically include only a few trees. Individual trees are often located several kilometers from one another.

The most numerous population was found in the Svatá territory; here, the trees are only a few hundred meters from each other. The last area where the researchers worked was the **Central Bohemian Uplands** landscape protected area – they took 40 samples. Here, service trees are found both in forest covers and in cultivated landscapes. Overall, this region demonstrated the greatest ability to regenerate populations; this ability is sustained both generatively (via seed propagation) and vegetatively (via root suckers) (Špíšek, 2009).

An UPGMA diagram showing the relationships between individual tree from Europe rerion forus on South Moravia and Central Bohemian Uplands.



Study comparing the three areas in question has been carried out. For study was used only a few molecular markers (5 microsatellites). The data point to a low genetic diversity but still describe small genetics differences between populations. However UPGMA tree (Unweighted Pair Group Method with Arithmetic Mean) reflects the structure present in populations. Small clusters (branches) describes relationships between individual samples. Samples from White Carpathian show relatively reach variability. Tree from this region we can found on every main cluster line. Compare with tree represented almoust tree growing in Central Bohemian Uplands (blue colour). Population from east Europe is represented green colour. According to the genetic analysis of variance (ANOVA), the intrapopulation variability is predominant here – it amounts to 94 %, whereas interpopulation variability comes to 6 %. The intrapopulation variability is rather high, at least in comparison with a similar study carried out in Hungary (67 %) (Kamm et al., 2009).



The service tree need forests with plenty of light, such as the Dolní Kapansko forest near Hodonín (1, 2010).

V. Service tree – ecology

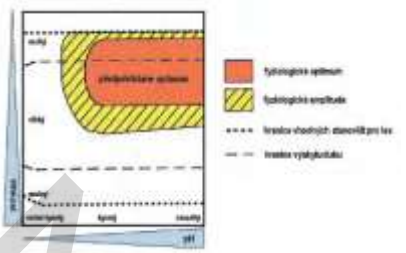
V. 1. Service tree habitat requirements

Service trees are heliophilous and thermophilic. They prefer soils that have a high nutrient content and aren't overly moist. Májovský (1992) characterizes them as a European Sub-Mediterranean floral element. Borhidi (1993) describes the service tree as a sub-oceanic species of alkaline oligotrophic forest ecosystem; its seedlings can tolerate semi-shade, but they are unable to cope with salinated soils. Service trees prefer warm, temperate climates with a longer vegetation period. They require a small, but constant supply of water from the subsoil, especially when they bloom or when their fruit ripens (Májovský, 1992). The root system of a service tree can access even water that is several meters bellow the tree (Kausch, 2000). Larrieu et al. (2013) compile accounts from France and Spain and point out that service trees are resistant to wind and grow on loam and clay soils with varying amounts of water. When young, the service tree can grow rather quickly, but it often refuses to grow close to other trees; therefore, it can often be found in places with less than ideal growing conditions. The service tree limiting factors are: not enough light, not enough nutrients in the soil without loam, too much water in the subsoil, cold and damp microclimate.

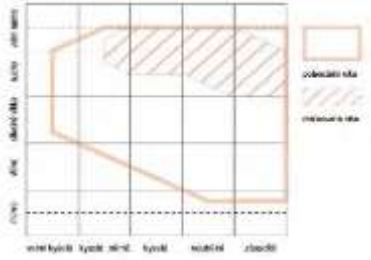
In places where it occurs naturally, the service tree prefers soils rich in nutrient content, especially in calcium: rendzinas and cambisols on limestone or dolostone (in the Mediterranean region in particular), and also brown earth on loess or diluvial soils and cambisols on non-carbon soils or marl (in Central Europe) (Rotach, 2003; Kausch, 2000; Benediková, 2009; Paganová et Bakay, 2010). The service tree can tolerate both acid cambisols with pH values between 5.5 and 6.5 and limestone rendzinas with pH values between 7 and 8 (Šály 1998 in Paganová et Bakay, 2010). To demonstrate the service tree habitat requirements better, we can use ecograms; the soil moisture and pH value seem to be the best indicators. Compared to the oak (*Quercus petraea*, *Quercus pubescens*), the service tree prefers a drier and more alkaline substrate (see the illustration) (Kellenberger et al., 2003).

The service tree grows best on deep soil horizons, because it can access water quite effectively there. These trees generally prefer a more porous (more permeable) substrate, but they can tolerate a higher content of clay in the subsoil as well. They can also grow in soils with a high content of stones – in Switzerland and Austria, the service tree does quite well in beech forests on limestone detritus (Kausch, 2000). In Hungary, Slovakia, Croatia, and England, it sometimes grows in shallow soils (less than 0.3 meters deep) with a high content of stones on detritus slopes; it usually appears in a stunted form there. The service tree hates inverse damp regions, such as valleys with rivers and waterlogged lands with a high water table. Higher relative humidity (and related fungal diseases) is another negative factor (for more on this topic, please read chapter VIII). Another limiting factor is temperature – late frosts in May can seriously hamper the reproductive ability of blooming service trees (bare in mind that this species is not the most competitive even at the best of times). As we can see, the species niche* of the service tree is rather wide, at least in terms of soil pH values and habitat humidity (Kellenberger et al., 2003). However, because of competition from other trees, it usually occurs within a limited niche of drier locations (see the illustration) (Rudow, 2010).

***Niche** – the space that the given organism occupies amongst other species with regards to its habitat requirements. A niche can be realized (e.g. in a forest) or potential (in an artificial habitat without competition from other species, e.g. in a garden)



Physiological ecogram for the service tree (without any competition) that demonstrates a hypothetical physiological optimum based on pH values and humidity in comparison with an optimum for the oak; modified based on Kellenberger et al. (2003).



An ecogram for the service tree in a habitat without competition (potential niche) and in a habitat with competition (realized niche) (Rudow, 2010).

In Slovakia, the service tree ecological prophile was compiled by Paganová (2008). Here, service trees prefer areas with average January temperatures between -1.8 ºC and -5 ºC, average July temperatures between 16.5 ºC and 20 ºC, and average annual tempertures between 8 ºC and 9 ºC. Furthermore, the service tree prefers slopes with plenty of sunlight facing west-, southwest-, south-, and south-eastward. Both in the Czech Republic and in Austria, researchers have noted similar climate requirements (Kausch, 2000; Rotach, 2003; Benedíková, 2009). In Switzerland, 7.2 °C seems to be the ideal temperature (Kausch, 2000). Young trees are resistant to mild frosts of up to -4 °C. The ideal annual precipitation for service trees in Slovakia and in the Czech Republic seems to be between 600 and 700 mm, while in Switzerland and in Austria, it is somewhat higher – between 700 and 800 mm per year. However, the service tree is quite resistant to environments with lower annual precipitation, and it is competitive even in areas with less than 500 mm per year (Kellenberger et al., 2003). When growing in places with annual precipitation between 500 and 600 mm per year (Spain), it needs alkaline soils with a rich nutrient content (Carrieu et al., 2013). The fact that it is resistant to droughts, especially during summer months, points to a great adaptive ability both in open country and in urban settings (Paganová, 2010).

In Central Europe, the service trees prefers areas with altitudes between 150 and 400 meters above sea level. In the northernmost part of its area of natural occurrence – in Saxony-Anhalt in Germany – it grows in altitudes between 140 and 300 meters that have annual precipitation between 550 and 650 mm. Since it is resistant to mild frosts, it can deal with altitudes between 600 and 650 meters above sea level when growing in Central Europe (Graz, Austria; Vizovické vrchy, the Czech Republic; Štiavnické vrchy, Slovakia). In Switzerland, it grows in altitudes between 380 and 700 meters. Near Munich, it can grow in higher altitudes (up to 800 meters). In the Balkan Peninsula, it grows at both sub-mountain and mountain levels (between 600 and 900 meters). If we were to continue south, we would find it in even higher altitudes – there were several individual trees found in the Mediterranean region that grew above 1,350 meters above sea level (Kausch, 2000; Pa- ganová et Bakay, 2010). In Sierra de Baza, above Granada (Spain), there are service trees growing in 1,800 meters above sea level (Garsia, 2013). In Greece,

there are service trees on Mt. Peristeri in 1,900 meters and on Athos in 1,350 meters above sea level (Kausch, 2000). It was demonstrated numerous times that adult service trees can deal with frosts of up to -30 °C, which is demonstrated by cultivations in the gardens of the Hørsholm Arboretum and in the Gisselfeld gardens in Denmark (Kausch, 2000; Rotach, 2003). According to Kausch (2000), Russian plant breeder Ivan Mičurin (1855 – 1935) thought about the service tree as a tree that would be able to produce fruit even amidst the frosts of Russian steppes, since it was able to withstand temperatures of -30 °C (Sokolov, 1954 in Paganová, 2010). Černobaj (2010) even states that service trees can deal with short-term temperatures as low as -37 °C. However, trees that are close to borders of populated locations can be prone to parasites and their fruit might not mature (Snow, 1988 in Paganová et Bakay, 2010).

Cultivation requirements of the service tree (*Sorbus domestica*) and the checker tree (*Sorbus torminalis*) in Spain (Coello et al., 2008, edited)

According to the study, both species are quite resistant to droughts and strong winds even when they grow in very shallow soils, where they often occur together. The service tree in particular can tolerate heavier soils with a higher clay or sand content. However, soils with a high sand content are quite low in nutrients, and so the service tree does not have the optimal growth conditions here. In terms of pH values, both species are quite tolerant – they grow both in acidic and alkaline soils (often with limestone subsoil). The checker tree temperature requirements during the vegetative period are somewhat more strenuous than those of the service tree. Both species can survive strong winter frosts. The service tree in particular is resistant to lower than ideal annual precipitation. During summer, it is able to tolerate up to two months of drought.

V. 2. The service tree requirements regarding the environment and nearby trees

The service tree naturally occurs in thermophilic forest ecosystems, mainly with alkaline and neutral subsoils – these include, for instance, the Central European thermophilic oakwoods and oak and hornbeam woods, or the sub-Mediterranean thermophilic forests. It can be also found in calcareous beechwods, for instance in Switzerland or Hungary, although it is rare in those regions (Kamm et al., 2009; Kiss, 2013). Within the Czech Republic, there are a few wild service trees in the Southern Moravia region in the Pannonian loess soil oakwood community (the *Quercetum pubescenti-roboris* association of the *Aceri tatarici-Quercion* union), where it is also stated as a diagnostic species (Roleček in Chytrý, 2013). In Slovakia, it naturally occurs in thermophilic oakwoods and calcareous beechwods (Miko, 2002). Soó (1966, 1973, 1980) argues that in Hungary, the service tree occurs in many diverse communities, from xerothermophilous oakwoods to mesophilic cornel and Austrian oak woods and oakwoods on loess soils to thermophilic detritus forests. Kevey (2008) points out several other vegetation types that include the service tree, especially thermophilic oakwoods and detritus forests with a higher concentration of sub-Mediterranean elements. In Serbia, the service tree is usually found in forest communities with dominant populations of pedunculated oaks (*Quercus robur*), Austrian oaks (*Quercus cerris*), and hornbeams (*Carpinus betulus*), but not in those with dominant populations of beaches (*Fagus moesiaca*) and black pines (*Pinus nigra*) (Miletić et Paunović, 2012). In Southern and Southeastern Europe, the service tree is also found in communities with *Quercus ilex* and *Q. conferta* (Jovanovič, 2000; Terme ntzi, 2006). When growing in extreme settings – on slopes, in detritus soils and on seashores, the service tree adopts a dwarfed, short, shrub-like form, which can only grow to be 5 meters tall with a trunk that has up to 30 cm in diameter (Croatia – Dvodelić, 2003; England – Hampton et Key, 1995; Italy – Bignami et al., 2001; Corsica). In open country, however, especially in Central Europe, service trees are notable for their large, centuries-old crowns that make them stand out in wineyards and gardens and in fields. In forests, core branches are subdued and crowns are higher, level with nearby trees. Similar to wild pear, apple, or cherry trees, the crowns have a lower volume. In Grime's classification, the service tree is a typical C class (a competitive strategy). This tree is tolerant to competition, but it doesn't like disturbed biomasses and it is heavily influenced by its long-term cultivation. In the original forest biotope, it always grows in small groups or completely isolated. In general, the harsher the climate, the drier and sunnier the place has to be for the service tree to grow there (Kellenberger et al., 2003).

A young service tree with an umbrella-like crown in the undergrowth of evergreen oak forest on the Croatian shore (1, 2012).

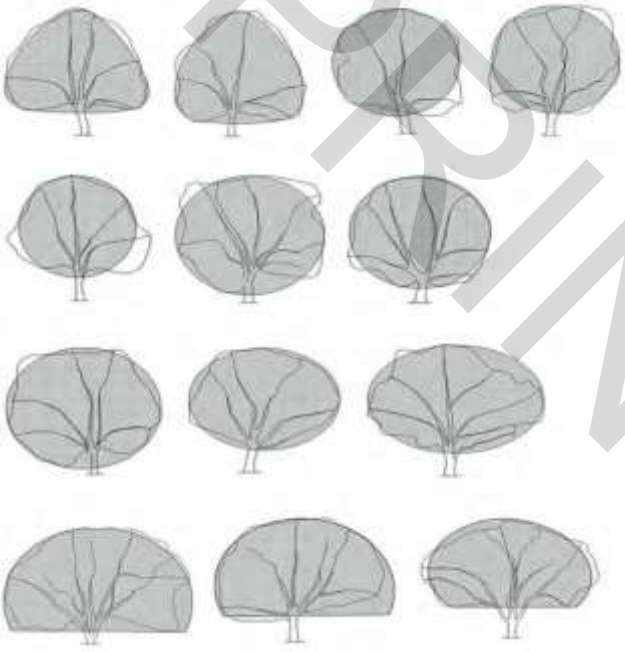
In forests, the service tree is more susceptible to competition pressure from other trees. Compared to other *Sorbus* species, it is more vulnerable to shading. Young trees have similar growth requirements as the bird berry (*Prunus padus*). Even though young trees have a relatively good growth ability, the species is competitively weak – this is the reason why these trees never form continuous groups. Coppicing occurs on forest borders, on sunny slopes and in extreme soil positions within forests (Rotach, 2003). Trees that successfully deal with competition grow to the main crown level and they sometimes have rather wide crowns (similar to the oak). It is clear that this species is heliophilous – these trees usually occur on forest slopes that face south-, southeast-, and southwestward (Paganová et Bakay, 2010). The trees that fail to grow to the main crown level of the forest suffer from shading, and they usually die (Paganová et Bakay, 2010). When growing in nutrient-rich soils, the service tree can grow to be taller than the oak; when service trees reach the harvesting age of 130 years, they can be up to 30 meters tall and their trunks can have up to 60 cm in diameter (Rotach, 2003). In the Mediterranean region and in Hungary, researchers observed that the service tree sometimes adapts to reaching a lower-than-ideal height and forms an umbrella-like crown, which gives it a higher assimilation ability (see the illustration).

On the left is a crown of a young tree (cca 10 years old), on the right a crown of an old one (cca 200 years old) in open country of wineyards and pastures. The White Carpathians, the Czech Republic (2. 2009).

However, it can live in this form only for a few years, biding its time and waiting for an opportunity. If such an opportunity presents itself, it can quickly outgrow other nearby trees. In forests with plenty of light that are in shallow or nutrient-poor soils, adult service trees can compete even with expansive ashes (*Fraxinus excelsior*). In open country, the requirements of the service tree are similar to those of grape vines (*Vitis vinifera*) or Persian walnuts (*Juglans regia*) (Kellenberger et al., 2003).

In terms of its ecological requirements, the service tree is also somewhat similar to the oak (especially to *Quercus petraea* and *Quercus pubescens*). These species are often found close together, both in forest locations and in open country. In these situations, the service tree crowns can take many different forms (see the illustration).

Trees in open country form different phenotypes, which differ not only in their fruits, but also in leaf patterns and the overall forms and shapes of their crowns (Maceková in Paganová et Jureková, 2012).



When growing in open country, service trees can adopt many different crown architectures. The illustration represents observed crowns from the Žemberovce location in Slovakia (Paganová et Jureková, 2012).

The ideal service tree phenotype for cities – an individual with a straight trunk and a regularly-shaped crown (Slovakia) (Paganová at Jureková, 2012; Uherková, 2013).

Competition from other species forces service trees to extremely dry areas. When growing in places close to the Northern border of its natural occurrence, or in higher altitudes, the service tree prefers sunny slopes facing southeastward. It seems probable that service trees will continue to spread to the North and the Northeast of Europe, to areas where their tolerance of droughts will constitute an advantage and where their competitiveness won't be hindered by their low reproductive ability (Hemery, 2009 in Paganová, 2010). When comparing yields of above- and below-ground biomasses of young service trees and young European wild pear (*Pyrus pyraster*),

Paganová and Jureková (2012) studied the ratio of root generation to the above-ground part and discovered that young service trees actually prefer to generate roots, which points to the ability to adapt to dry environments. In case of certain phenotypes* of service trees with ideally-shaped crowns, this ability to tolerate water supply insufficiency and high temperatures, combined with the ability to grow in nutrient-poor soils with limited soil space, can be very beneficial for both open country and urban plantings (Paganová et Jureková, 2012). Amongst both fruit and forest trees, the service tree is amongst the most resistant to smog and pollution – it might be advantageous to plant it in urban and industrial centers (Kausch, 2000; Benediková, 2009; Pártl, 2012).

***Phenotype** – a composite of all the traits of a given individual. A phenotype is an expression of both the organism's genetic information (genotype) and the influence of environmental factors.

The gradual improvements of our knowledge on the Sorbus domestica ecology in 1992, 2008 and 2013 (Kausch, 2000; Rotach 2008, 2013).

A schematic map of the area of natural occurrence of the service tree according to the Zürich Institute for Terrestrial Ecosystems (ETH) in Switzerland (Rudow, 2010).

VI. Service tree – distribution

Man

The service tree is the European species of the *Sorbus* genus; it also occurs in a few isolated locations in Africa and Asia. In many European countries, service trees are considered to be an indigenous species. In Switzerland, Hungary, and Austria, this tree is registered in the Red book of endangered species and considered to be facing extinction. Based on the available data, there are 50 adult service trees in Luxembourg, 500 adult trees in Switzerland, up to 500 adult trees in Austria, and 6,000 adult trees in Germany. Researchers estimate that there are some 10,000 service trees in Greece and in the territory that belonged to former Yugoslavia (Kausch, 2000). In Hungary, there are probably between 2,000 and 5,000 service trees, while the Czech Republic can boast up to 1,500 adult trees. In Slovakia, we know of more than 400 adult trees and it is estimated that there are between 2,000 and 3,000 trees overall. *Many service trees can remain unnoticed, like this tree masked by other nearby trees in Polichno in Moravia (1, 2012).*

As evidenced by the maps, the area of natural occurrence of the service tree is rather large and rugged. When we compare the current information about the distribution of this species with the information that we had 20 years ago, we see that it is rare, but also relatively unkown in Europe. In the whole area, service trees are sparse, if not downright rare (Drvodelić, 2003; Moinet, 2009). Even at the beginning of the 21st century, new locations of the occurrence of this species are still being discovered. Quite recently, the service tree was discovered even in the Lake Van region between Turkey and Iran.

Today, there are several areas that we consider to be the centers of the occurrence of the service tree – the Balkan Peninsula (Bulgaria, Croatia, Montenegro, Serbia, Macedonia, Greece, Albania), the Italian Peninsula (Italy), and Southeastern France (Bignami, 1998; Moinet, 2009). The occurrence of the service tree in Central Europe – in Germany, Austria, the Czech Republic, Slovakia, or Hungary – is considered to be marginal. However, it is interesting to note that the largest and probably the oldest trees of this species in the world grow here, in Central Europe (see chapter IX). Service trees in Southern and Southeastern Europe also have shorter lifespans and are less diverse (in terms of habitats, fruits etc.) than those in Central Europe (Kausch, 2000) – this might be due to the fact that the first group was subjected to long-term cultivation. It seems reasonable to asume that the species found new optimal conditions in Central Europe after an ice age, or that it had optimal conditions here before the ice age (and its occurrence in Southern Europe is not indicative of an ideal environment). In Swiss lowlands, service trees are considered to be postglacial relicts from a warmer period (Rotach, 2003; Rudow, 2006). On the Iberian Peninsula, service trees are rare, but they occur over a rather large area (especially in Spain). They can also be found on the border of their natural occurrence in Great Britain, in Eastern Ukraine, and also as far as the Crimean Peninsula and the Caucasus Mountains (Krška et Fialová, 1998; Šefl, 2007). In Europe, service trees can also be found in botanical gardens that are not within their natural area of occurrence – one such botanical garden is in Denmark, in Northern Europe, for example. Service trees are documented in Northern Africa as well – in Morocco, Libya, and Egypt. They can also be found in Asia, specifically in Turkey, Syria, Lebanon, and Israel (Kausch, 2000).

VI. 1. Central Europe

Distribution of service trees in the Czech Republic – green color indicates approximate borders of the area of their natural occurrence, dots indicate known populations (2, 2014).

The Czech Republic

The occurrence of the service tree in the Czech Republic is limited to the České středohoří region and to Southeastern Moravia. At the beginning of the 21st century, researchers estimated that there were only some 200 or 300 trees in cultivated areas and roughly the same number in forests (Hrdoušek et al., 2003). 10 years later, however, it was estimated that there are actually roughly 600 adult trees in forests: 330 trees in Ždánický les, 90 trees in Pálavské vrchy, 70 trees in the Hodonínsko region, 20 trees in the White Carpathians, 20 trees in the Vizovická vrchovina region and its surroundings, and 120 trees in the České středohoří region. The densest population was discovered in Ždánický les in the Svatá territory – in some 2,200 hectares of the forest, there are more than 300 documented adult trees. However, the actual numbers might be much higher. Forester Martinásek (Uherková, 2013) of Milovický les in the Mikulov region estimates that there are more than 1,500 service trees in this area alone. Similarly, researchers estimate that there can be up to 900 adult trees in open country – 350 trees in the Slovácko wineyards, 250 trees in wineyards in Southern Moravia, 50 trees in the Haná region, 100 trees in Luhačovická Zálesí and Southern Moravian Wallachia, and 150 trees in the České středohoří region. The densest concentration of large trees that are more than 100 years old was found on the Žerotín u Strážnice hill, an area with 73 large adult trees spread over 250 hectares of wineyards and orchards. In the Czech Republic, the service tree is not a protected species – the law protects just 25 especially large individual trees. The largest ones are shown bellow. However, we have no paleobotanical evidence of cultivation and consumption of fruit of the service tree at the moment. (We do have such evidence for many other trees – the cornel, the apple tree, etc.) Historically, the very first discovery of the service tree seeds within our territory occurred in the Early Middle Ages in Mikulčice (between the 8th and the 12th century) (Opravil, 1998) and in Olomouc (between the middle of the 10th century and the middle of the 12th century). Olomouc can also boast the discovery of seeds from the High Middle Ages (from the 13th century) (Opravil,1994). Seeds from the Late Middle Ages (between the 15th and the 16th centuries) were discovered in Tábor (Opravil, 1985) and in Uherský Brod (Opravil, 1976).

Possibly the largest forest service tree in the Czech Republic, which grows in Ždánický les. Its trunk has 2.13 meters in circumf. (1, 2013).

Remarkable service tree "Koštálovská" near Jenčice with a trunk circumf. 3.95 meters in. The largest service tree in Bohemia (2, 2012).

Vital service tree "Adamcova" on the Žerotín hill near Strážnice with a trunk that has 4.62 meters in circumf. The largest fruit tree in the Czech Republic (1, 2007).

Well-formed and well-preserved seeds from Uherský Brod point to a possible cultivation (Tetera, 2006). It is possible that the oldest living trees in Southeastern Moravia date back to this period.

Products made from service trees, Tvarožná Lhota (1, 2013).

According to oral tradition, the service tree came to both Moravia and Bohemia during the Roman era and was connected to the art of wine-making; other sources tell us that it was brought here during the wars with the Ottoman Empire. It is quite probable that these colonizers brought many plant species with them, possibly including cultivated service tree species with large fruits, but there is no evidence that would indicate that the service tree was not present in this territory before. Today, the service tree is considered an indigenous species in the Czech Republic. When it occurs naturally, it grows in cornel and Pannonian loess soil oakwood communities (Čížková et al., 1999; Chytrý et al., 2013). In the *Nová květena ČSSR* publication (Dostál ,1989), this species is listed as indigenous to Hungary, Austria, and Slovakia (the White Carpathians and other regions); the author argues that in Moravia and Bohemia, it should be considered a wild species. In the *Klíč ke květeně České republiky* publication, Kovanda (2003) admits that this species can actually be at least partially indigenous to Southern Moravia.

There is no natural barrier between Southwestern Slovakia and Southeastern Moravia that would prevent the spread of this species to the Moravian part of the White Carpathians.The tree analyses confirmed the occurrence of the species of trees associated with thermophilic cornel oakwood communities, which include the service tree (and also the sweet chestnut, the downy oak, the European cornel etc.), as far back as the Neolithic era (near Střelice) and the Bronze Age (near Čeložnice) (Prudič, 1997). According to Tetera (2006), these are the original wild fruit trees growing within the territory of the Czech Republic since the end of the last ice age: the European wild pear, the European crab apple, the wild cherry, the European dwarf cherry, the sour cherry, the European cornel, the wild grape vine, and the service tree.

The service tree museum and the spring "service tree festival" in Tvarožná Lhota (1, 2009).

A large service tree in Zádveřice na Moravě with a trunk that has 4.58 meters in circumference (1. 2010)

The populations in the České středohoří region in Northwestern Bohemia are not considered to be indigenous (Prudič, 1998), even though service trees are coppicing here and they grow in oak and hornbeam woods. A genetic analysis might help make the situation clearer. Historically, the spread of the service tree was probably much greater. Service trees were victims of the intensive forest cultivation of the 19th century and many larger trees were probably cut down during the socialization of countryside in 1950s – in this period, many trees were cut down to allow for plot mergings. The efforts to save the service tree began in the 1990s and they were led by the Uherské Hradiště research station that introduced thousands of service trees into both open country and forests (Benediková et Prudič, 2000).

Traditionally, the service tree fruits were used in Southern Moravia as a digestion medicine (in their dried form), and more recently to make service tree brandies, ciders, preserves, and marmalades. Althought it is rare now, this tradition still survives in some places. Since 2001, Tvarožná Lhota have organized its own "service tree festival", which presents more than 120 service tree brandies; since 2004, service tree fruits are presented during the event called "service tree harvest". Since 2003,there has been a small service tree museum here, as well as a service tree educational trail. Since 2001, the service tree has been planted as a memorial tree in more than 100 villages, mainly in the Moravian Slovakia region. In 2001, a service tree gene pool orchard consisting of 182 grafted service trees from 70 adult trees with large fruits was created in the Židlochovice forestry business, in the Diváky part. This orchard encompasses one hectare and it is used to study the growth, reproductive ability, and forestry use of the service tree. However, as of 2013, the trees have failed to produce any fruit. There is another gene pool orchard of 35 trees with large fruits of 9 different fruit types from various locations in Southeastern Moravia. This orchard was created in 2008 on the slopes of the Travičná hill, which overlooks Tvarožná Lhota. In the International Year of Biodiversity (2010), the Czech Republic Ministry of the Environment declared the service tree as one of the most endangered species in the country. In 2012, the service tree was declared the forest tree of the year of the Czech Republic.

Slovakia

In Slovakia, the service tree is considered rare. There were findings of burnt wood from the La Tène era, the era of Celtic expansion and the Roman era (Beranová, 2011).

Distribution of service trees in Slovakia – green color indicates approximate borders of the area of their natural occurrence, dots indicate known populations (L. Bakay, 2013).

Historical documents do not have a lot to offer on the subject. Holuby (1888) describes types of cultivation – the seedlings found in forests were planted in fields near the southern border of the Trencsén county. At the time, the service tree was considered to be a foreign fruit tree that was introduced to Slovakia artificially (much like the sweet chestnut). Michalko (1961) was the first one who pointed out that the service tree was indigenous to Slovakia, particularly to drier areas with thermophilic communities from cornel and gromwell oakwoods to cornel beechwods (Miko, 2002). During normalization, the interest in the service tree was virtually non-existent. In the *Pestovanie lesných drevín pre ovocie*, a book on the cultivation of forest trees from 1977, the service tree is not mentioned once.

In the 1990s, however, rare tree species were once again deemed interesting. Benčať (1995) published the first detailed overview of known service tree locations. Between 2001 and 2004, Slovakian researchers carried out a study including the whole territory of Slovakia and discovered 134 tree in 14 different locations. In 2008, there were 242 documented isolated service trees and 22 documented service trees in forest covers in 24 different locations (Paganová, 2008). During their mapping, Brindza et al. (2009) documented 167 trees in 17 other locations. In 2013, 224 more trees were discovered in the Slovakian part of the White Carpathians (Uherková, 2013). Strašivtáková (2003) mapped service trees in the Little Carpathians. Vozárová (2011) mapped Levice and its surroundings – she discovered 28 trees, some of which included genotypes suitable for the Levice forestry business gene pool. At the moment, there are some 400 documented service trees in Slovakia (Paganová et Bakay, 2010). It is probable that the actual number is higher; there might even be as many as 2,000 or 3,000 adult service trees in Slovakia.

In this country, the service tree occurs naturally in altitudes of up to 600 meters above sea level (Benčať, 1995). The area of its natural occurrence is identical to the area of vine grape cultivation, which Hungarian botanists sometimes call "the Moesz line" (see the map). The easternmost occurrence of service trees in Slovakia is connected with their occurrence in Ukraine's Zakarpattia Oblast. In the whole of Slovakia, documented service trees are usually at least 100 years old. Even the easternmost documented tree found in the Sobrance village has a trunk that has 70 cm in diameter and researchers estimate that it is 150 years old (Maxim, 1998). A study showed that service trees can be used in forests as production trees that tolerate dry and warm places (Pagan et Pa- ganová, 1998).

A public measuring of the service tree near Modra in Southwestern Slovakia – in 2013, its circumference at breast height (130 cm) was 5.03 meters (1, 2013).

The Slovakian Agricultural University in Nitra focuses on the study of the phenology, ecological requirements, reproductivity, and conservation of service trees. The researchers in Nitra described ideal phenotypes for urban settings (Paganová et Maceková, 2011). For more on this, please see chapter V.

In Slovakia, there are two gene pool orchards of service trees. The first one is in Dolné Plachtince (near Levice) and it is maintained by the Central Control and Testing Institute of Agriculture. This orchard includes 60 service trees grown from seedlings from 10 Slovakian locations and one Austrian location. The second orchard was created in 1998 in Geberanica and it is maintained by the Technical University in Zvolen. This orchard includes 9 genotypes. Furthermore, the Slovakian Agricultural University in Nitra maintains a botanical garden with 4 clones divided into 19 individuals, and there are also 2 clones divided into 9 individuals in a research institute in Bojnice (Brindza J., 2009).

A couple of service trees (namely service trees in Devín, Modra, Devičany, and Hrušov) are now protected by the state. The service tree in Devičany (in the Levice region) is one of the oldest service trees in the whole of Slovakia. Its trunk has a circumference of 4.6 meters and it is estimated that this specimen is more than 400 years old. The service tree in the Modra village, also in Southwestern Slovakia, is the largest known service tree – in 2013, its trunk had a circumference of 5.03 meters and a diameter of 160 cm. Today, this tree can be considered the largest documented service tree in the world (see the illustration on the previous page.)

Saving a service tree

Ľubomír Zubák recorded an interesting story about the "Urbánkéch" service tree and its "rescue": "In the 1930s, there were still old orchards in this area. Overall, they included more than 20 large service trees. Due to collectivization that took place after 1950, all fruit trees were destroyed by caterpillar tractors or dynamite.

Of all these service trees, only two survived these dark times – the Blaškéch and the Urbánkéch service trees that were both in the middle of a large new field area. However, the first one was gradually worn down by plowing, and later hit by a lightning, twice; it died in 2000. The Urbánkéch service tree, which is owned by the Urbánek family and which is more than 200 years old, survived, and it was fenced and treated in 2009. In the same year, this tree (that has a circumference of 2.6 meters) gave a bountiful harvest – 1.3 tons of fruit."

Protecting the "Urbánkéch" service tree's roots from plowing (Ľ. Zubák, 2009).

Hungary

Distribution of service trees in Hungary – dots represent locations where researchers carried out detailed genetic studies (Nyári, 2010).

In Hungary, service trees are quite rare and they are protected by the law. They can usually be found in forests with plenty of light and with sparse undergrowth or in cultural landscapes, such as wineyards or orchards (Nyári, 2010). In Hungarian, the service tree is called "házi berkenye", or "fojtós berkenye" (a "strangling" service tree) in some dialects. It is interesting to note that the Hungarian word "berkenye" is derived from the Slavic word "břekyňa" (Benkő et al.,1984). There are both acheo logical findings and historical sources that document that service trees have been grown in this territory for at least 2,000 years. Archeological excavations uncovered service tree fruit and seed remains – all were found close to Roman agricultural estates. The artefacts from Tác Fövénypuszta were dated back to the 2nd century, the artefacts from Kékkút to the 3rd or the 4th century, those from Fenékpuszta to the 5th century, and those from Fonyód-Bélatelep to somewhere between the 7th and the 9th century (Gyulai, 2001). Several Hungarian researchers were interested in this tree early on, namely Gayer (1929), Rapaics (1940), and Kárpáti (1942, 1960), and they thought that it was indigenous to Hungary. Gayer (1929), however, also admitted that there was probably a strong human influence that helped the service tree to spread. Modern botanists usually consider the service tree to be indigenous to Hungary (Soó, 1980). Rapaics focused mainly on landscape, orchard, and pomological aspects, while Kárpáti was more interested in the distribution of the service tree. Pénzes (1959) described 6 different forms of service tree fruits found in various parts of Hungary. The distribution of the service tree in Hungary is closely tied to highlands and mountainous areas of the Bükk Mountains, the Mátra mountain range, the Bakony region, and the Mecsek mountain range2000). In the western part of Hungary, service trees are often cultivated in orchards with sweet chestnuts (Vegvári, 2000). The identification of service tree genotypes important for fruit growing represented an important step forward (Végvári et Pallagi, 1994; Végvári, 1999). The authors focused on service trees with fruits with diameters longer than 3 cm. They also discovered which genotypes had a larger quantity of seeds, and were therefore suitable for seed orchards. For more information, please read chapter XII. Nyári studied genetic relationships of 196 service trees from several provinces,especially from the Danazug and Zemplén regions. He identified a strong anthropogenic influence. These findings therefore lend credence to the theory which states that service trees with large fruits were cultivated by fruiterers as early as in the Middle Ages (Nyári, 2010).

A collection orchard of 42 service tree grafts with large fruits from the whole territory of modern Hungary. It is located in the Pilismarót village on a slope overlooking the Danube (V. Orsigety, 2013).

The largest forest service tree in a forest near Visegrád. Its trunk has a circumference of 1.85 meters (1, 2013).

The largest service tree of the Zala county. This tree is located near the Vindornyaszolos village and it is approximately 300 years old (1, 2013).

In 2000 and 2013, the service tree was declared the Hungarian tree of the year. Since 2001, it is protected by the law in the whole of Hungary and its social value was set at 10,000 Hungarian forints.

Service trees in Hungary usually grow to be between 15 and 20 meters tall (Bartha et Mátyás, 1995). Their fruits are both apple- and pear-shaped and they are between 1.5 and 3 cm large. As is the case in the rest of Europe, the service tree populations in Hungary are not particularly numerous. The overall number of adult trees is estimated to be between 2,000 and 5,000 (personal statement, Sonnevend, 2013). The Pilismarót village on a slope overlooking the Danube can boast a large collection of 42 service tree grafts from the whole territory of modern-day Hungary. This private collection, which belongs to a former forester Kiss Balasz, is probably the largest one in the country. Furthermore, in the Zala wineyard region in the Balaton national park, there were 140 documented service trees by the autumn of 2000 and 170 documented open country trees and 25 forest ones (where the coppicing takes places) by 2012. Researchers estimate that today, there might be as many as 200 or 300 service trees in this region. This area features many large-fruit cultivars of various colors and shapes. The fruits are conical or oval, and rather large, and they can be yellow or red. They are prized for their taste. The largest tree in this area is probably 300 years old and its trunk has a diameter of 104 cm and a circumference of 3.35 meters. The largest documented service trees in the whole of Hungary can be found in the city of Tokaj in the Csöpögő völgy lowlands; their trunks have 110, 120, and 121 cm in diameter (Bartha, 1996). The largest forest tree that we know of can be found near Visegrád; its fruit is up to 2 cm large. Its trunk has a circumference of 1.85 meters. The tree is roughly 20 meters tall and it is some 150 years old. It was left untouched, along with several other service trees and checker trees, and can be found in forest part 49b.

Before the Second World War, service tree fruits were sold in markets. In the Zala region, the service tree used to be used for wine clarification, mainly by German colonists. The practice stopped around the 1950s. Today, service trees are used mainly to make service tree brandies. This tradition dates back to the 18th century. The service tree brandy was always considered a healing delicacy that was not to be mixed with other fruit brandies. Several companies still make the brandy today. Other uses include dried fruits (for indigestion) and, more recently, marmalades (personal statement, Sonnevend, 2013).

Austria

During the last century, Austria saw a marked decrease in the number of service trees. The extant populations sometimes grow in forests, such as dry oakwoods, hornbeam oakwoods, sparse pinewoods, and limestone beechwoods. The largest known forest populations occur near Bad Vöslau and Wolkersdorf (Steiner, 2009; George et al., 2015).

The largest known service tree in Austria grew near Gießhübl (near Vienna). It had to be cut down in 2009 (2, 2013).

However, the species is most often found growing in open country – wineyards, orchards, and fields. There are roughly 500 large service trees in Austria; the oldest ones are probably 350 or even 400 years old. Service trees, or "Aschitzenbaum" in Austrian German, grow mainly in Lower Austria in the surroundings of Vienna and in Northern Burgenland. In Styria, we are aware of just two old trees that grow in its Southeastern part, close to the border with Slovenia (Kirisits, 2008). The largest documented service tree in Austria has been protected by the law since 1934 and it was located near Gießhübl (near Vienna). Its trunk had a diameter of 144 cm and a circumference of 4.5 meters and the tree was 17 meters tall, with a crown that had 14 meters in diameter. Each year, it produced some 500 kg of fruit. However, the tree fractured in 2009 (see the illustration). The oldest service tree in Austria grows in the Vienna Woods in a garden next to a house in Aigen. Its trunk has 4.01 meters in circumference, but it is just 6 meters tall, as its crown has been cut severly. Researchers estimate that it can be some 400 years old. Even though it was damaged by a fire and it is partly hollow, it still produces fruit, which has 51 % germinability (Kausch, 2000). The service tree fruits are sometimes used to make traditional jams, purées, jello, liquers, vinegar, prized brandies, or even wine (Kirisits et al., 2000). The wood of the service tree is one of the heaviest kinds of wood available in Europe. Although rare, it is sometimes used to make craft tools and musical instruments, mainly flutes and bagpipes (Kirisits, 2008).

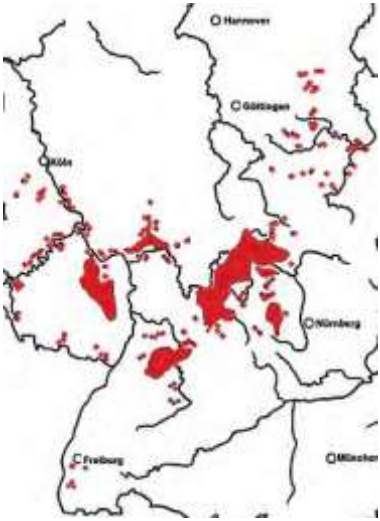
In 1999, a clone collection of service tree fruit types had been created in Klosterneuburg with clones collected by T. Kirisits. Originally, it had roughly 40 genotypes; unfortunately it had to be eradicated in 2016. Nevertheless these clones and additional ones collected in Austria have been preserved at the Austrian Research Centre for Forests (BFW) and are part of a conservation seed orchard. The service tree was declared the Austrian tree of the year in 2008 and has a high priority in the national efforts to conserve forest genetic resources (Konrad et al. 2015).

The clone orchard in Education and Research Centre for Pomology in Klosterneuburg (M. Ruzicka, 2013) which unfortunately was

VI. 2. Western Europe

Germany

As a xerothermophilous tree species, the service tree spread to Germany from Southwestern France via the Rhône river valley sometimes between 9 000 and 8 000 BC (Kausch, 2000). Archeological discoveries prove that service trees with large fruits were also present in Germany in the Roman era (Beranová, 2011). Today, the service tree naturally occurs in German forests, mainly in Bavaria, Baden-Württemberg, Hessia, Rheinland, and the Main river catchment area. To date, the northermost documented trees were found in Saxony-Anhalt. However, the number of service trees has been gradually decreasing since the 19th century due to changes in landscape cultivation, both in Germany and in Europe as a whole. The existence of this species is threatened mainly by intensive cultivation of forest and field monocultures and the decline of forests with several species of trees and plenty of light and of landscape transition zones. The natural reproductive capabilities of the service tree are not powerful enough to save the species, as the original biotopes quickly disappear (Kausch, 2000). Germany pays close attention to service trees since 1980. The activities of research centers and several forest nurseries led to the service tree being declared the German tree of the year in 1993, which marked the beginning of an effective protection of this species. Foresters prefer trees with tall trunks, while fruiterers like to focus on those with large fruits. Even today, forest service trees are sometimes used as sources of extremely hard and colorful wood that is used in cabinetmaking and to make veneer. In the Middle Ages, Germans prized service tree fruits for their high content of aromatic and healing substances. In some places, fruits are still used to deal with dysentery, enteritis, and stomach discomfort. Even by the beginning of the 20th century, people still differentiated between several pomological types of fruits based on their shape and taste. Today, the fruits are sometimes used in winemaking to make famous "service tree-apple wines",



Distribution of service trees in Germany in 1992 (3, 2000).

A service tree marmalade, wine, licquer, and brandy, Germany (3, 2000).

A gigantic tree that grew in Virsberg (reprophoto, 3, 2000).

that are amongst the more expensive ones (Kausch, 2000). Other prized service tree products include marmalades, purées, compotes, licquers, and aromatic brandies. However, the number of adult service trees is too small to keep up the production.

The largest service trees in Germany have more than 100 cm in diameter (with a circumferences of 3.15 meters) and the locals estimate that they can be more than 250 years old. There was a truly gigantic tree that grew in Vilsberg (see the reprophoto). Unfortunately, it died in 1970. This giant had 142 cm in diameter and its trunk had a circumference of 4.45 meters. The tree could have been 350 or 400 years old. Dendrochronological studies carried out in similar climatic conditions in the Czech Republic suggest that trees with a circumference of 4 meters (or more) can be older than 400 years (see the table in chapter IX). Today, the largest trees in Germany are in Hessia and Baden-Württemberg. They can grow to have more than 130 cm in diameter and more than 4 meters in circumference. In Bavaria and Baden-Württemberg, there are trees that are more than 30 meters tall. The tallest service tree in Bad Kissingen is 34 meters tall (Kausch, 2000). Before 1987, researchers estimated that there were some 4,500 service trees. By the beginning of the 21st century, more trees were found and documented; today, researchers estimate that there are 6,000 adult service trees in Germany – 2,000 in Baden-Württemberg, 2,500 in Bavaria, 100 in Thuringia, 200 in Saxony-Anhalt,

Cultivation of large-fruit service tree grafts in an orchard in Veitshöchheim near Wurzburg (3, 2000).

One of the largest tree grows near the Ockstadt village in Hessia. Its trunk has a circumference of 4.40 meters (1, 2010).

200 in North Rhine-Westphalia, 500 in Hessia, and 600 in Rheinland (Kausch, 2000). In 1994, W. Kausch founded an association called Corminaria. Its seat is in Frankfurt, it publishes a magazine that also bears the name "Corminaria" and it organizes events to help and to protect two forest fruit tree species – the service tree and the checker tree.

Luxembourg

In Luxembourg, the service tree is now considered the most endangered indigenous tree species. It spread into local forests from France (Kausch, 2000). At the beginning of the 20th century, the largest service tree in the country was a tree in Weydert near Fels, which had a circumference of 3.36 meters at ground level (Chadt, 1913). Today, the tree survives as a torso (see the illustration). A change in forest cultivation, which occurred some 200 years ago and which led to the increase in the number of so-called low and middle forests, translated into a sharp decline in rare trees (including the service tree). Dense modern-day sprucewoods and beechwods with tall trunks are not suitable for this species, as it is not that competitive. Declining numbers are evidenced by maps – in 1902, there were 1,104 documented trees, while in 2003, there were just 87. However, the service tree is not quite forgotten and it still has a place in this country – in 1993, it was declared the tree of the year, and in the following years, the Administration des Eaux et Forêts forest management unit, the state of Rhineland, and the German Research Institute for Forest Ecology and Forestry carried out a wide-scope cultivation and planting operation. This operation focused on planting service trees near forest trails and forest borders, where they had plenty of light (which was optimal for their growth). Many more service trees were planted along roads, in orchards, and in parks. There are still a few places in Luxembourg where they make the traditional service tree alcoholic beverage called "Spierendrëpp".

A torso of the largest service tree in Luxembourg, which is in Ferme Weydert and which has a circumference of 3.30 meters at breast height.

In 1996, a new stamp depicting the service tree was issued. It depicted the largest service tree in the country (when it was still healthy and growing) and it was hoped that this stamp would raise the popularity of the species.

Denmark

According to Kausch (2000), there are just four documented service trees in Denmark. All of them are in botanical gardens – one in the Hörsholm arboretum, one in Copenhagen, one in a school park in Gisselfeld and one in another school park in Charlotenlung. This last tree was planted around 1850 and it is still productive. The cultivation of adult trees outside its area only shows the ability of this species to survive in extreme conditions.

Service tree fruits on a service tree in the Copenhagen botanical garden

Great Britain

From a botanical point of view, the territory of Great Britain is one of the best documented areas. The discovery of two productive service tree populations by Mark Hampton in 1983 (in the Porthkerry Park in Southern Wales), was therefore somewhat surprising and picqued the interest of the international botanical community. Until then, the service tree was considered to be an introduced species that could be found only in a few botanical gardens. The newly-discovered populations are located on limestone cliffs near Cardiff and they are smaller than their counterparts on the continent. Their blooms are pink and their fruits are pear-shaped, although there are some apple-shaped ones as well (Hampton et Kay, 1995).

Distribution of service trees in Great Britain (Hampton et Kay 1995).

The largest open country service tree on the cliffs of Southern Wales, southwest of Cardiff (1, 2012).

There were roughly 15 individual trees on the cliffs, all in areas that were not easily accessible. They were shrub-like in appearance; their trunks had just between 10 and 25 cm in diameter. However, researchers estimate that these populations are probably 300 or 400 years old (Clarxon, 2000). For more information, please read chapter IX. At the moment, the Porthkerry Park area includes some 80 or 90 service trees. By the end of the 19th century, the Oxford Botanical Garden planted new service trees in the Wyre forest. The fruits of these trees are green and brown and between 2 and 2.5 cm large (Hampton et Kay, 1995). Other trees were planted in Gloucestershire, Horseshoe Bend, Shirehampton (near Bristol) and London.

A service tree and its fruit. The Wyre forest, 2009 (Davis landscape Architecture, 2013).

A service tree and its fruit. Kew Gardens, London (anonym, 2014).

Switzerland

In Switzerland, the service tree is currently considered a rare, but indigenous tree, a postglacial relict from a warm period between two ice ages, which is evidenced by the fact that it is usually found in oakwoods (Rudow, 2006). First attempts to catalogue all the individual service trees in Switzerland began in 1986. By 2000, the project included900

Distribution of service trees in Switzerland (Rudow, 2006).

foresters and 50 botanists. Thanks to these mapping efforts, general population became more aware of this interesting tree species. Soon after, researchers created a map indicating the distribution of this species. Furthermore, they collected samples from many trees and carried out genetic analyses, and then created a gene pool orchard. In 1997, the Swiss Federal Institute of Technology in Zurich and The Federal Office for the Environment created a project that was designed to support rare tree species (including the service tree). Today, there are three main service tree populations that are well documented and studied – one in Schaffhausen, one in the Table Jura Mountains, and one in Basel. Researchers estimate that there are roughly 500 service trees in Switzerland (with trunks that have more than 10 cm in diameter). These trees are typically isolated and they grow alone. Many forest service trees grow in beech and oakwoods and beechwods in altitudes lower than 700 meters above sea level. In the Canton of Schaffhausen, there are some 200 trees – the average density is 4.2 trees per 100 hectares. The detailed genetic analyses of the populations were carried out here. During these studies, researchers mapped the neighboroughing forests in Germany as well. However, no service trees were found there, probably due to intensive cultivation

(Kamm et al., 2009). The largest service trees in Switzerland are 32 meters tall and around 200 years old. Locals are also reviving the tradition of using the service tree fruits to make the "cormé" licquer (Brütsch et Rotach, 1993).

The service tree and its fruit. Estavayer-le-Lac in Switzerland (A. Rudow, 2010).

France

In France, service trees can be found mainly in central and Southern parts of the country. A few service trees can also be found in Burgundy and in the Northern part of France. The service tree grows at the mesomediterranean, supramediterranean, submountain, and mountain levels up to 1,400 meters above sea level (Larrieu et al., 2013). There are also some service trees on Corsica, where they can be found both in lower altitudes and on sunny westward slopes as high as 1,300 meters above sea level. However, all the populations have poor regenerative abilities and people are generally not interested in cultivating them.

"On every agricultural estate, there are… service trees, quinces, and medlars, even if they are few in number," wrote J. Pesche about the Sarthe region, southwest of Paris, in the 19th century. The value of service trees is also evident from historical sources – in 1920, five service trees were sold for half of the price of the Petite Soudinière estate in Vibrace. Furthermore, in some places, it still retaines its "double status", both as a fruit tree and as an estate tree, same as, for instance, the oak or the walnut tree, as stated in the *Code of local customs* from 1937 (Moinet, 2009).

Distribution of service trees in France, data gathered from numerous mappings (Larrieu et al., 2013).

A large service tree in Marmoutier near Strasbourg (S. 2010).

In terms of archeological findings, large-fruit service trees are documented for the La Tène era, the era of Celtic expansion (400 BC to 0 AD) and the Roman era (0 AD to 400 AD) (Beranová, 2011). Since time immemorial, the service tree fruits were used to make a sparkling drink called "cormé", especially in Central France. In his *Discussion on fruit wines* from 1577, Charles Etienne argues that "cormé" was actually the first wine made in France. By the 19th century, however, it was merely a cheap replacement of grape wine that was given to farm laborers. Consequently, service tree cultivation declined in many regions over time: it was gone from Normandy by the end of the 16th century, gone from the Maine-et-Lorie and Haut-Maine departments by the middle of the 18th century, gone from the Sarthe department by the middle of the 19th century (see the diagram). As fruit cultivation intensified and as there were more and more production orchards and wineyards, service trees had to make room for grape vines, apple trees, and pear trees. Many service trees were also destroyed due to plot unifications. In 1873, the France Pomological Congress recommended service trees to be cultivated, in later years, however, the service tree was not mentioned in the list of desirable fruit tree species, because it was unable to compete with new varieties of apple and pear trees that had higher and quicker yields and larger fruits that were easier to process and to store.

The diagram of the trunk circumferences of trees in the Sarthe region – most of the 600 measured trees fall into the 160 to 200 cm category, which would make them roughly 150 years old and suggest that they were planted during the era when the service tree was still popular (4, 2009).

Traditionally, service trees were planted along hedges and roads, on the borders of gardens and of plots etc., which made them undesirable later on, since fruiterers usually preferred fruit production orchards. Due to this pressure, the culture of service trees vanished, and it is also the reason why there are apple and pear orchards in France, but no modern-day service tree orchards (Moinet, 2009). In La Ferté-Bernard (in the Sarthe department), there is a fruit orchard called "des Calots" which includes several service tree grafts.

Surprisingly, some older French people who live in smaller villages still have great respect for this tree: "The service tree is sacred!", "The service tree is a king's tree!" (Moinet, 2009). Interestingly, it has different names in different regions. In Southern France, it is usually called by its Latin name – "Sorbier" –

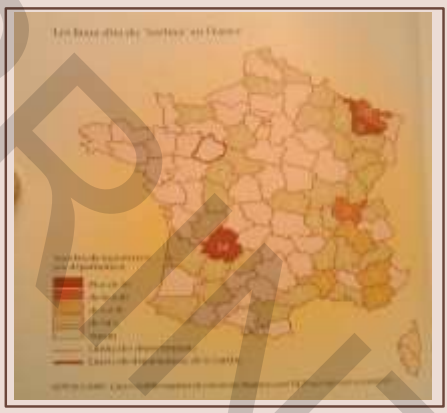
The largest known service tree in France with 4.57 meters in circumference. It grows near Baune in Burgundy (A. Desbrosse, 2012).

while it is commonly called “Cormier” in Southwestern France and “Epruyer” in Burgundy. In 1900, *Revue Horticole* described the “Methuselah” service tree (which grew in Western France) as a “Géeant Cormier”. H. Massé wrote: “It is a giant double tree with a circumference of 5 meters at ground level and of 7 meters at the height of 1 meter above ground. Hollow, but still very productive. Its large crown is visible from some distance. It has looked the same for at least 100 years and it produces more than a ton of fruit a year.” (Häne, 2002)

In France, there are still some giant service trees in open country. In the Sarthe department, there are some dozen trees that have at least 3 meters in circumference. The largest tree with a circumference of 3.85 meters grows in Maine-et-Loire; according to E. Moinet (2009), it is currently the largest known service tree in France. In 2012, however, researchers studied memorial trees near Baune in Burgundy and they found a service tree with an astounding circumference of 4.57 meters, which disproves Moinet’s claim (A. Desbrosse, personal statement, 2012). Today, France is the biggest producer of wood from wild fruit trees, and the service tree is therefore getting back into forests. It also constitutes a useful tree species for dry Mediterranean areas where it can serve as a pioneer species for future forests (Moinet, 2009).

Toponymy of “Cormier” and “Sorbier” in France

Distribution and frequency of toponym “Cormier”. The densest occurrence is in the Sarthe department – 99 local names.



Distribution and frequency of places named “Sorbier”. The densest occurrence is in the Dordogne department – 24 local names.

According to a dictionary from 1950, the Sarthe department had the highest number of proper (179) and regional (184) names that were derived from “Cormier” (that is of Celtic origin). 143 of those names were linked to villages. According to the website of the French National Institute of Geographic and Forest Information, there are 636 “Cormier” names in the whole of France (on 1:25 000 maps); 99 of them are in the Sarthe region. The Dordogne department has 24 “Sorbier” regional names (of Latin origin) and the highest density of “Sorbier” surnames. It is interesting to note that the spread of the “Sorbier” surname is also connected to the spread of watermills (with horizontal wheels) in the Southern part of the country (Moinet, 2009).

Naturally coppicing service trees in the Maquis shrubland in Corsica (2, 2013).

A productive service tree near Porto in Corsica (2, 2013).

VI. 3. Southern Europe

Spain

On the Iberian Peninsula (Spain and Portugal), the service tree is called "Serabel común" but also Serbera, Cerollera, Jerbo, Zurbal, Acerolo, Sip, and Capudo. The fruits of wild service trees are documented for this region as far back as the Paleolithic era (Beranová, 2011). Service trees occasionally grow on unproductive slopes, fallows, fields, and hedges, especially in the Northern half of the country. According to Bolos (1984), the most important population of service trees is located in the Northeastern part of Spain, in the Pyrenees, in areas with altitudes of up to 1,400 meters above sea level. Larrieu et al. (2013) also argue that the focal point of the occurrence of the service tree in Spain is the Eastern part of the country and the regions of Castile and León, La Rioja, and Aragon, where it prefers altitudes of up to 1,000 meters. In Aragon, there are several large isolated trees. The largest ones are in Bordón(Teruel) and

A service tree in its natural habitat in the Huesca region (Garsia, 2013).

A service tree in Sierra de Baza, Granada (Garsia, 2013).

in Boltañe (Huesca). More can be found in the La Litera region or in Bagués in Zaragoza. In Sierra de Baza (above Granada, in Southern Spain), service trees can be found in altitudes of up to 1,800 meters above sea level, their fruits mature in October and November and they are 2 or 3 cm large (see the illustration).

In the whole of the Sierra de Baza natural park, service trees often grow close to old estates and villages (regardless of soil types). Some individuals can grow to be extremely large. You can see beautiful trees in the Don Martin valley in Barranco Segura, in the Las Juntas de Gor territory or close to a recreational spot called Pinarillo (Garsia, 2013). In Baltanás, in the Cerrato region in the Palencia province, and in As Burgas, there are more than 50 service trees that were planted in small wineyards roughly 50 or 100 years ago (see the photo). Today, the wineyards are largely deserted and partially transformed into wheat and barley fields. Even without care and harvests, the trees often grow on border ridges and slopes, or even in the middle of cultivated fields. However, they are threatened by plowing and autumn stubble burning (even though that practice is illegal now). Consequently, the trees are often weak and some do not even bloom (Garsia, 2006). The service tree was also found in other regions, namely in Santander, Asturias, León, Old Castile, New Castile, Valencia, Andalusia, Majorca, and Menorca (Kausch, 2000), as well as in Valencia, Sierra Nevada, Sierra de Cazorla, and Segura-Baleares (Garsia, 2013). In 1898, M. A. Trouelle, a French pharmacist from Trouville, wrote: "In Spain, the service tree is usually planted in wineyards and vines are often grafted on wild service trees. A fermented drink made from fruits and water is used to cool oneself, or it can be left to ferment with grape juice." (Moinet, 2009). Traditionally, the fruits were used to make compotes and "enristrarlos" (or "beads") – a fruit was cut in half, put on a string, and left to dry in the sun. The blooms were used to make tea (Garsia, 2013). The service tree was declared the tree of the year for 2010/2011 by Fondo Forestal Ibérico, a Spanish organization that takes care of all the forests in Spain.

A service tree in an agricultural landscape of Aragon (Fondo Forestal Ibérico, 2010)

A service tree in former wineyards in Baltanás in the Palencia province, Spain (S, 2006).

Italy

In Italy, the service tree is called "sorbo", from the Latin word "sorbum", which has been in use for at least 2,000 years. From time immemorial, the service tree has been used as a fruit tree in Italy, especially in poor foothill areas where its fruits have been used to make a fermented drink similar to a pear cider. Historical mappings and documents from the last 100 years show that although rare in the whole of Italy, it has been cultivated in quite a few places. Today, the service tree is almost forgotten here; it is slowly disappearing and its fruits are consumed only by birds (Lieutaghi, 1975). In a few areas, the fruits can still be bought at local markets (the surroundings of Ascoli, Naples). Some farmers dry the fruits (on strings or in sieves) to be used during the winter both as a food and as an indigestion medicine. Its wood used to be used to make high quality craft tools and equipment (Bignami, 2008).

In general, the service trees in Italy have two main forms of fruits – *maliformis* and *pyriformis*. The historical classification of varieties is largely forgotten now. According to the mappings, service trees are spread over the whole of Italy and they employ many types of soils, with the exception of soils with a large clay content and wetlands, and also the Po lowlands, where they haven't been found as of yet. They usually grow in altitudes of up to 900 meters above sea level (Bignami, 1998). When occurring uncultivated, the service tree often adopts a dwarfed, shrub-like form and it grows in forests with dry soils, especially in forests with the downy oak (*Quercus pubescens*). The trees in the Northern part of the country, in the Italian part of Tyrol, often grow uncultivated, mainly on slopes facing southward and southeastward. The tallest documented service tree is 24 meters tall. The look of service trees is often influenced by the location where they grow. In Bolzano and its surroundings, service trees in open country often adopt the stunted shrub-like form. When they are moved to gardens, however, they grow to be tall, proper trees (Kausch, 2000). The largest service trees in Italy usually have around 3 meters in circumference and crowns that are roughly 10 meters tall, and they are some 300 years old (see the illustration) (Guidy, 2007; Bignami, 2009).

A large service tree with a circumference of 2.7 meters near the Ro Ferrarese village in the Emilia-Romagna region (Bignami, 2009).

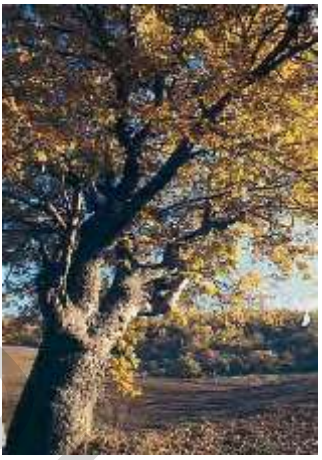
Service tree fruits shown during the festival of forgotten fruit in Casola Valsenio in the Emilia-Romagna region (Bignami, 1998).

A large-fruit service tree in the Ercolano village at the foot of Mount Vesuvius (1, 2009).

There are still some large service trees in a village that bears a telling name – Sorbo. The village is close to L'Aquila. In 2013, there were 9 documented trees in and around this village; researchers estimate that they are between 30 and 150 years old (they have up to 1.8 meters in circumference). The locals usually don't have any use for service trees, causing the trees to be overgrown with shrubs (see the illustration). The densest service tree populations can be found in the Campania and Sicily regions (Bignami, 2000b). Here, service trees can be found in wineyards and in gardens, but also in abandoned orchards on the slopes of Mount Vesuvius and Mount Somma, as well as on the slopes of Mount Etna (in Sicily). However, the number of trees is declining, and so is the interest in them (Bignami et al., 2001; Bignami, 2008). Even so, there are still a few service trees near Naples – some of them are left to grow wildly, some are cultivated, coppiced, and fertilized – that produce fruits that are later sold. According to a field study from 2007, there are dozens of adult service trees at the foot of Mount Vesuvius. These trees only grow to be 5 or 10 meters tall, but their fruits are large – they can have 4 or 5 cm in diameter (see the illustration). The largest tree at the foot of Mount Vesuvius, with a circumference of 165 cm, can be found in a farmstead in Trecase.

Botanists try to protect service trees locally, working in designated protection areas. Service trees can be bought in fruit tree nurseries, usually as seedlings. Since the end of the 20th century, both the general public and researchers have been more and more interested in this largely forgotten fruit (see the illustration).

The fruits of the old Indigniente variety grown at the foot of Mount Vesuvius (1, 2009).



The largest documented service tree in Italy, growing in Predappio, with a circumference of 2.9 meters (Guidy, 2007).

Abandoned service trees in the Sorbo village in the Apennines, 100 kilometers east of Rome, and the largest service tree with a circumference of 178 cm (1, 2013).

Service tree planting in the Monte Salviano natural reserve, 2009.

Service tree planting in Avezzano (Italy)

In 2009, a small forest of 70 new trees (consisting of hornbeams, ashs, and service trees) was planted in Avezzano, in the L'Aquila province, right at the heart of the Riserva Naturale Regionale del Monte Salviano natural reserve. It was a part of the "The tree is your friend" project. Many important local figures have attended the event that was organized on the World Environment Day – Antonio Floris, the Mayor, Aureliano Giffi, the Deputy Mayor, Brunella D'Alessandro, the director of the reserve, and Stefano D'Amore, the PR director of the reserve, as well as representatives of the state forest department, state police, and local police, botanist Mark Fattoretti, and pupils from schools in Vivenza-Marini, Mazzini, and San Simeoni (www.marsicalive.it).

Between 1991 and 1996, the fruits of 50 service trees from 10 locations in Central Italy were analyzed as a part of the EU GENRES 29 project pilot study (Bignami, 1998). Researchers compiled a list of old fruit varieties in the Monte Pollino region and discovered several adult productive service trees there (Figliuolo et al., 2010). It seems that cultivating service trees (for their prized wood) might be beneficial to Italy; at the moment, many sample projects are underway (Bignami, 2008).

Greece

In Greece, the service tree is called "σουρβιά" – sourviá, sourvia, okiaki, sourvia imeri – and it is well-known throughout the country. There might be as many as 10,000 service trees here (Dafis et Jahn, 1975 in Kausch, 2000). The trees grow to be 15 to 20 meters tall. They are especially numerous near Thessaloniki in the Chalkidiki region. Here, service trees grow in altitudes between 400 and 900 meters above sea level, often in a combination with the Italian oak (*Quercus conferta*), which is usually shorter than the service tree. The trees that grow in the

Service tree fruits from Kastoria, 2012.

Distribution of service trees in Greece (Boratynski et al. in Kausch, 2000).

Disappearance of service trees from Kastoria

Before 1965, each village family in the Kastoria region owned one or two wineyards. In each wineyard, there was a service tree or an almond tree, and these trees were as valuable as the wineyards themselves. The harvests of the fruits, or "sourva", took place at the same time as the wineyard harvests. It went even farther – each grape basket, or "kosiores", had a branch with service tree fruits on it. The baskets were brought home and the service tree branches were ritually hung in a dry cellar or a storeroom. During 1960s, farmers largely stopped cultivating the wineyards, but they didn't abandon their service trees, which continued to prosper. They were used until 2007 and 2008, when it was decided that they had to be destroyed to allow for plot unification. There are only three surviving trees in Vines, and only 7 or 8 in Chavos.

highest altitude are located on the Peristeri mountain (1,900 meters above sea level) and on Mount Athos (1,350 meters above sea level). Today, only older Greeks living in smaller villages are familiar with the service tree. Some of them still use their fruits, or "sourva", as an indigestion medicine, or for a general well-being (Termentzi, 2006). In Greece, service trees can hold their own thanks to root coppicing, which also helps them to deal with frequent forest fires (Paganová et Bakay, 2010). According to studies carried out by the Aristotle University of Thessaloniki, mature service tree fruits are potent antioxidants and they can be helpful in diabetes treatments (Termentzi, 2006).

Serbia, Croatia, Macedonia

There are far fewer service trees in the Northern parts of these countries than in their Southern parts; however, the farther south we go, the smaller (and less interesting, in terms of economy) the trees become. As in other regions, service trees are sparse here (Kausch, 2000). According to Jovanovič (2000), service trees typically grow in Balkan oakwoods. Uncultivated service trees can grow right on the shore in evergreen shrub-like oakwood covers, where they survive thanks to their large umbrella-like crowns, which gives them the advantage over the evergreen oak (*Quercus ilex*) (see the photo). In this territory (part of former Yugoslavia), service trees were cultivated for their fruit. In cultural landscapes, service trees grow close to wineyards and on pastures, but also near crossroads and in fields.

A young tree with an umbrella-like crown in forest undergrowth near Poreč in Istria (1, 2012).

The largest service tree in Croatia which grows in the Ogulin village (Drvodelić, 2003).

Trees on pastures near the Suknovci settlement near Knin in Croatia. The larger one has 45 cm in diameter and it is 8 meters tall (1, 2008).

According to a study carried out by D. Drvodelić (2003), the trees grow to be 10 or 15 meters tall (although those growing on the shore of the Mediterranean Sea are just 5 meters tall and they have no more than 50 cm in diameter). The largest service tree in Croatia grows in the Ogulin village at the foot of the Velika Kapela mountain range – it is 17.5 meters tall, has 65 cm in diameter, and grows at 275 meters above sea level (see the illustration). Mratinić a Kojić (1998) state that in Serbia, service trees grow in oakwoods from Fruška Gora to Prokletije (Kosovo) and from the Drina to the Timok. Researchers decided to select 6 mother trees from the surroundings of Banja Luka to create a gene pool of this region, because the number of service trees is declining sharply here (Stefanovič et al., 2012). Drvodelić (2003) states that ancient Croatians and Serbians used this tree to make wheels and gears for watermills. However, the varieties are largely unknown. Individual trees can produce more than 800 kilograms of fruits. Researchers estimate that there can be some 2,000 individual trees in populations around Dubrovnik and Split.

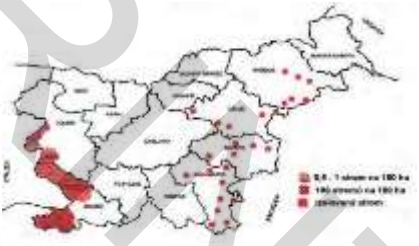
Freely coppicing service tree and its fruits near the Vratnica village in the Šar Mountaints, Macedonia (2, 2010).

A productive service tree and its fruits near Motovun in Istria (1, 2012).

Kausch (2000) estimates that there can be as many as 10,000 service trees in the former territory of Yugoslavia. According to field studies carried out in Croatia in 2008 and 2010, service trees are rare here; only older people are familiar with them. Paradoxically, even the professional community of Croatian national parks (Istria, central Velebit) is largely unfamiliar with this tree. The service tree fruits can occasionally be seen on markets in Zadar, Zagreb, Dubrovnik, Kotor, and Bar.

Slovenia

In Slovenia, the service tree is called "skorš" and it prefers altitudes lower than 500 meters above sea level. It grows mainly in warmer parts of the country, typically in those that are also associated with wine-making. It can be found mainly in Southwestern Slovenia along the border with Italy (and close to the Adriatic Sea). In the rest of the country, service trees are quite rare. On average, their fruits are usually 2 to 5 cm large. During the reign of Maria Theresa, it was a standard practice to plant fruit trees (including service trees) along roads and on fields to be used by the locals. At that time, service tree fruits were used to filter grape wine and to keep it from getting murky. However, winemakers later introduced much more effective sulfur, which caused service trees to loose their value (Djurasević, 2011).



Distribution of service trees in Slovenia (3, 2000).

A service tree on a stamp issued in 2013 in Slovenia.

The "Mrázov skorš", one of the largest service trees in Slovenia (Djurasević, 2011) .

The fruits used to be preserved mainly by drying; they were then crushed during the winter and used to make tea. Crushed fruits were also sometimes added into bread (Baznik, 2012). The trees are still cared for today, as their fruits represent an effective indigestion medicine and they can be used to make marmalades, wines, a special licquer (fruits pickled in rakia), and a prized brandy that has a specific taste reminiscent of crushed service tree fruits. Their resilient wood was used to make parts of wheels and wine presses (Djurasević, 2011). The tallest forest service tree found in Slovenia is 22 meters tall and it has 70 cm in diameter (Kausch, 2000). The oldest trees usually grow in isolation, but close to estates. The very oldest service tree is located in Krška Vas in Brežice; it has a circumference of 3.76 meters at breast height and it is probably some 500 years old. It survived many terrible storms and it was hit by a lightning. The largest service tree is called the "Plavecov skorš" and it can be found in Mursky Vrh near Maribor; it has a circumference of 3.83 meters (see the illustration). Service trees appear in a lot of varieties here, they reproduce both naturally and by grafting, and they reach sexual maturity in just 5 years (Baznik, 2012). Today, is are some organized effort to cultivate this interesting fruit tree. In 2011, Slovenia issued a stamp with a service tree on it. The Slovenian forest service declared the "Mrázov skorš" the tree of the year – it can be found in the Loka pri Žusmu village in the Styria region and it is one of the largest service trees in the country, approximately 200 years old, with a circumference of 3.2 meters at breast height and with a crown 18 meters tall (Djurasević, 2011).

The "Plavecov skorš", one of the largest service trees in Slovenia (1, 2014).

A blooming service tree on a pasture near Gernik in the Romanian Banat (L. Volařík, 2013).

VI. 4. Eastern Europe

Romania

In Romania, a few service trees were found in the Southwestern part of the Romanian Banat and in the Retezat Mountains. Some service trees were also found in Czech villages in the Banat, which were founded in the 18th century. Here, service trees grow on pastures and fields and they coppice in forests with enough light. In the Banat, people call them "jařabinka", while "skoruš" is a name reserved for the medlar. We know that some service tree populations can also be found in the Southern part of Transylvania and in the mountainous region north of Constanța. Service trees were also found in the area between Southern Carpathians and the Danube (Kausch, 2000).

The largest known service tree in Bulgaria, which was cut down in 1995 (3, 2000).

Bulgaria

In modern-day Bulgaria, service trees are rare, but well-known trees. Findings of Paleolithic remnants of fruits and seeds tell us that service trees were used as a food source here. Some of these findings date back to 1700 or 1500 AD (Kausch, 2000). Today, service trees can be found mainly in the Southern and Northern parts of the Balkan Mountains. Some populations were also discovered on the shore of the Black Sea, as awell as in the hinterlands. Service trees can also be found in the area between Sozopol and the Turkish border or near the city of Melnik, which is famous for its long tradition of wine-making. In the Northern part of Bulgaria, service trees grow in altitudes between 350 and 750 meters above sea level. In its Southern part, they can be found in altitudes of up to 800 meters above sea level. The trees have between 90 and 130 cm in diameter and they are probably 200 or 300 years old. In 1995, the largest known service tree with a diameter of 135 cm was cut down; however, there are 14 other trees nearby and the largest one has 129 cm in diameter (Kausch et al., 1997). Today, we know that the number of service trees in places where they used to be common is merely half of what it was before. During the mapping efforts, researchers found just 292 adult trees in 203 locations, even though some 384,000 checker trees and 128,000 service trees were planted during the 1960s in an effort to save these trees (Kausch, 2000).

Ukraine

In the Ukraine, service trees can occasionally be found in the Carpathian Mountains, especially in areas of grape vine cultivation. They also naturally occur, along with 7 other *Sorbus* species, on Southern and Southwestern slopes of Crimea (Krška et Fialová, 1998), where they have to deal with frequent droughts. In Crimea, they usually grow in larger populations; many such populations can be found in the mountains near Novorossiysk (Kausch, 2000).

Roughly 60-year old tree in the Kiev botanical garden (V. Mezhenskyj, 2010).

In Ukraine, there is a long tradition of service tree cultivation, especially in Crimea, which peaked around the 17th or 18th century. The Tatars used to plant service trees around their settlements in so-called "čair" forest-orchards fenced by stones. However, many trees were destroyed after the Second World War, as the families that were cultivating them (Tatars, Bulgarians, etc.) got deported from Crimea (Černobaj, 2010). Today, only a handful of service trees in the Ukraine are older than 100 years. There is some historical evidence, however, that there were service trees in Crimea that were 300 years old but had only 70 or 80 cm in diameter (personal statement, V. Mezhenskyj, 2012).

Today, service trees are mainly used as a food source – their fruits are consumed while still fresh. In the old days, Ukrainians used to make a lot of products from them – cuvees with wines, preserves, marmalades, and apple-service tree purées that served as fillings of various kinds of candy.

Service tree fruits have one distinct disadvantage – they mature on trees and this process can take a long time (up to a month), which translates into a long harvest. This might be one of the reasons why people ceased to cultivate these trees. No one is interested in them anymore, forest nurseries are not nursing new seedlings. However, it seems that the service tree is gaining some popularity with amateur gardeners (personal statement, Černobaj, 2013).

In the Carpathian Mountains, individual villages retain their own service tree variaties, for instance Barvinok 1, Barvinok 2, Medvedivska. In other parts of

Fruit variability from the collection of the Nikita botanical garden in Crimea (2, 2012).

the Ukraine, service trees are found only in botanical gardens. In Kiev, they survive frosts of up to -23 °C. In Eastern Ukraine, fruiterers cultivated new varieties that are more productive and more resistant to frosts – "Rumjane jablučko" and "Rumjana hruška" (personal statemens, Mezhenskyj, 2012). For more information on service tree varieties, please see chapter XII.

V. Africa and Asia

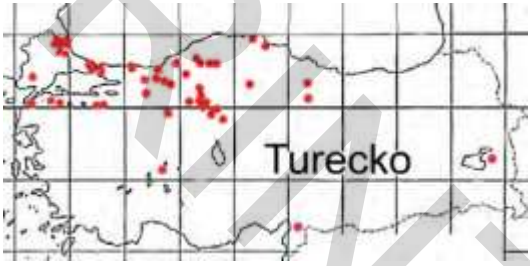
An isolated tree in the Todgha Gorge in Morocco (2, 2009).

In Northern Africa, service trees were found in Egypt, Algiers, and Morocco. The first mention of service trees in Africa was found in the herbology notes of the Botanical Institute of the University of Göttingen in 1861. Battandier and Trabut (1902) later documented their existence in Bouzareah in Algiers. Mair (1976) documented service trees on the slopes of the Amedrous Mountain (1,900 meters above sea level) in the Middle Atlas Mountain Range, in the area southeast of Amizmiz in the High Atlas Mountain Range, and in the Al Haouz province in Morocco (Kausch, 2000). Today, service trees can be found mainly in botanical gardens (in Cairo, Casablanca, Marrakesh, etc.) or in public greenery in the university town of Ifrane. Service trees can also be found in submountain oases (see the Todgha photo) or near the Mediterranean shore. The fruits of these service trees

are often dried by the locals and used in gastronomy, both in sweet and salty dishes. For instance, they can be cooked and served with couscous and mutton.

Turkey

In Turkey, service tree fruits are often sold at markets during autumn. It is probable that when it came to direct consumption, people used to differentiate between several varieties (Diapulis, 1933 in Kausch, 2000). The fruits can also often be bought in a dried form as a medicine that is used to treat diarrhea.



Distribution of service trees in Turkey (Ercisli, 2004).

According to Kausch (2000), one of the main areas of service tree occurrence in Turkey lies north of the Bosphorus, with another one in Northern Turkey close to the Black Sea shoreline. Kárpáti (1960) claims that in this region, service trees were cultivated for their fruits. These trees often grow on the borders of forests, in gardens and in wineyards. They can grow to be between 4 and 10 meters tall and they can be found in altitudes of up to 900 meters above sea level. If they appear in forest covers, they always grow apart from one another and they attempt root coppicing (Kausch, 2000). Another important location of service tree

occurrence is Cappadocia. This region is famous for its sandstone formations with rock-cut houses and temples. Many valleys (or at least those with enough water) boast small fields of local farmers. They often grow wheat or grape vine and their fields are usually lined with trees, including service trees, but also figs, pomegranates, mulberries, and citruses. Service trees are smaller here, reaching only 5 or 6 meters. They often expand into open country. The easternmost service trees in Turkey were found close to Lake Van (near the border with Iran). Since they are so small, their wood is not that useful, and so they are cultivated mainly for their fruits, and sometimes their leaves (which are used to make tea). In the local traditional medicine, the fruits are also used to treat stomach pain, diarrhea, and, purportedly, even gastric ulcers (Hrdoušek et al., 2003; Termentzi et al., 2006). However, as the general public is not that interested in them, local populations can be regenerated only through their own reproductive abilities.

Large-fruit service trees near Ürgüp in Cappadocia (2, 2008).

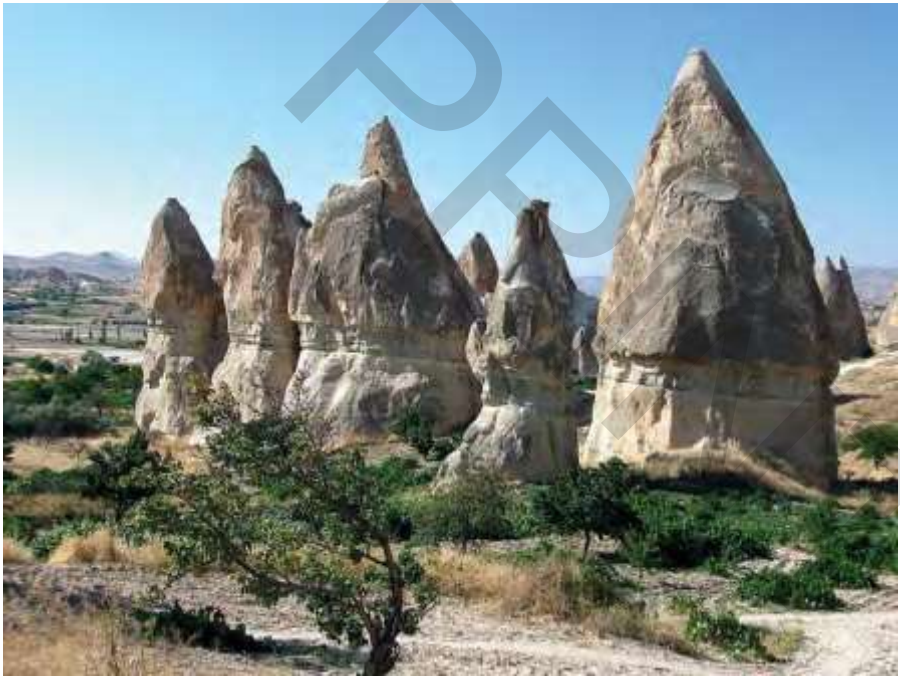
Service tree fruits on display during a market in Istanbul (2, 2008).

A service tree seedling in Cappadocia in Central Turkey (2, 2008).

Syria and Israel

In Syria, service trees can be found in the parks of Hama, for instance. In Israel, service trees can be found in the Jerusalem botanical garden, in the Bahá'í gardens in Haifa, or in Tulkarem (Palestine).

Fruits and a service tree label from the Jerusalem botanical garden, Israel (2, 2012).



This extremely dry part of Cappadocia in central Turkey can boast quite a few service trees (2, 2008).

A service tree grafted on a medlar in Pliskovica in Slovenia. After 9 years, the weak compatibility between the grafter and the graftee really shows (1, 2014).

VII. Service tree – propagation and plantation

VII. 1. Propagation

Every living organism tries to fulfil two basic needs: to obtain enough nutrients for its growth and to pass on its genetic information to its progeny. This also holds true for the service tree. In nature, we can observe two methods of propagation – generative and vegetative. Sexual (generative) propagation is dominant and allows for greater variance in progeny, and therefore, also for higher adaptation material. The service tree produces a large amount of fruit, especially in so-called seed years. Regardless, we still haven't determined the cause of the rarity of this species in European woodlands and farmlands (Rotach, 2003).

In the north, the distribution is affected by the climatic conditions, especially by the short vegetation period. The seeds usually germinate in 13–19 weeks (Benediková, 2009). In some cases, this relatively short period might not be sufficient to protect the seeds from spring frosts (Prudič, 1998). The temperature also poses a limiting factor for flowering, when late May frosts significantly limit the reproduction of plants (see picture). May rains also decrease the pollination of flowers and increase the susceptibility of young annual shoots to diseases. In the entire distribution area, there is also noticeable pressure from animals shortly before the winter season – the animals graze on fruit (high content of sugar and organic acids), seeds (high fat content) and seedlings (healing properties, nutritional value) of this late fruit bearing tree (Brütsch et Rotach, 1993). The service tree has a disadvantage of low germinability and frequent lying of seeds* that can be overcome by stratification (germination calm), see chap. Stratification and seed germination). According to Prudič (1998), the rarity of the species is caused mainly by this scarcity of germinated seeds and seedlings in nature.

The seed contains a relatively small amount of nutrition supply, which negatively impacts the vitality of seedlings in less than favourable conditions (Brütsch et Rotach, 1993). The service tree has also a low ecological competitiveness both

Seed year in service trees is marked by rich blossoming in spring (1, 2009)

Blossoms destroyed by May frosts (2, 2009).

*Seed year – a year marked by increased fertility in long-lived plants (e.g. trees).

*Seed laying occurs in plants with dormancy (germination calm), when the seeds do not germinate in the following year despite being in the soil during winter.

on artificial sites and in the natural environment, which decreases its chances of propagation and wider distribution (Paganová et Bakay, 2010). On the other hand, the exceptional sprouting capacity of the roots of an old plant contributes to the fact that the service tree is capable of remaining on a particular site, sometimes for centuries (Rudow 2010). The distribution of service trees has been significantly impacted by human activity for the past 2 000 years, at least, because its natural renewal capacities are, for numerous reasons, insufficient. According to Kausch (2000), the first written mentions of species propagation via "roots and seeds" come from Theophrastos (371–285 BC).

Generative propagation

In the past, the service tree has spread mostly via seeds, which results in the high degree of tree and fruit variation nowadays (Brindza et al, 2009). In trees propagated by seeds, the first fruit appears after 7–15 years in optimal conditions in the entire distribution area. The first sign of fertility is the cracking of bark on the trunk base. Mertan (1995) states that service trees grown from seed start to bear fruit at the age of 20–30 years, and forest service trees even at the age of 30–40 years. Newer research states that the onset of fertility is at the age of 7–10 years in forest service trees at the age of 10–15 years (Kausch, 2000; Hrdoušek et al., 2003). Trees with a damaged root system bear fruit sooner. The onset of fertility can be expedited by lacerating the bark or by strangling the young trunk by a thicker wire (so called "circling", Špíšek, 2009). Self-pollination can be observed in isolated service trees that grow more than 10 km away from other trees. This is also called inbreeding (Chloupek, 2000), which can result in the growth of infertile albino specimens (up to 20% of germinated seeds) or specimens with weaker growth and lower resistance to fungal infections (Dagenbach, 2001; Hrdoušek et al., 2003). The generative propagation is important for the viability of the species.

Damage of service tree seeds and fruit by rodents (2, 2007).

In our latitudes, the service tree depends on pollination by insects. The tree seed dispersal is tied to zoochory*. Animals are lured to the service tree by attractants, such as the taste and the smell of fruit, and also by the nutrients content (sugars and proteins) (Kamm et al., 2009). According to Herrter (1989), a substantial amount of service tree seeds in the Mediterranean is distributed by carnivores and predators who supplement their diet by consuming the rotting fruit. Regardless, the most important consumers of the service tree in nature are herbivores, such as bucks and deer, and omnivores, such as wild hogs.

*__Zoochory__ – seed dispersal via animals, usually mammals and birds. The seeds are undamaged by the digestive tract and gain increased germinability.

The seeds usually pass through the digestive tract of bigger animals almost completely undamaged. An important group of fruit consumers consists of small rodents, who usually consume and digest the fruit along with seeds (see fig.). Overpopulation of rodents can therefore lead to a decrease in seed availability (Špíšek, 2011). Frugivorous birds distribute the seeds over large distances.

The seeds use so-called primary dormancy mechanisms* that protect the seeds from germination before the onset of unfavourable conditions (Luštinec et Žďárský, 2005). For instance, this prevents the seeds of service tree, which usually germinate in spring, from germinating in the warmer periods of autumn. Longer periods of low ambient temperatures (lower than 5 °C) causes the dormancy to break, because it contributes to the elimination of inhibitors, such as abscisic acid (ABA), which strengthens the dormancy. Exit from dormancy can be artificially accelerated by the surface application of agents containing fytohormones, especially combined with ethylene, or with gibberellins (Luštinec et Žďárský, 2005). The breaking of the dormancy period can also occur after the passing of the seeds through the digestive tract of some species of animals (mammals and birds), when the seed tegument is weakened. This decreases the function of germination inhibitors (Chlebík, 2000), and leads to water absorption by the seed, which further leads to swelling. The physiological characteristic of swelling is present in both live and dead seeds. In seeds containing a live embryo, there is an intensive breathing function and also an enzymatic and hormonal activation. This activation is marked by swelling. If other external conditions are fulfilled (such as temperature, oxygen content and in some, also the lightning intensity), this starts the mobilisation of nutrients stored in the reserve organs of seeds (wombs) and leads to germination (Luštinec et Žďárský, 2005). Wombs are carried upwards, then comes the growth of first assimilation leaves. In service trees, there are usually two womb leaves, in rare cases, there can be 3 or 4. The first seedling leaves are usually partially fused and may be devoid of hair (see fig.). Service tree seedlings are difficult to locate and determine in nature due to their similarity to mountain ash seedlings. According to Šefl (2007),

Mountain ash stipule (above), service tree stipule (below) (Šefl, 2007).

The first womb (round) and assimilation leaves (2, 2009).

***Seed dormancy** (from Latin dormans, sleeping) – evolutionary adaptation of plants to overcome unfavourable periods. Plant germination can be slowed down (inhibited) genetically, via fytohormones, or by an impervious seed coat that has to be damaged. It is interesting to note that seed dormancy hasn't evolved in plants growing in tropical areas.

Seedling in a sunny forest on Bídnice hillside (361 above sea level) in České Středohoří, Czech Republic (2, 2012).

Ripe fruit undamaged by fermentation process are a good source of seeds for propagation (1, 2011).

service tree seedlings can be conveniently determined by their stipule. Service tree stipule is (in contrast with the stipule of mountain ash) petioled, segmented (into two parts), both parts are serrated along the ledge and are further divided into two lobes. The main vessel runs almost through the whole of the stipule. The stipule is joined at the base of the leaf petiole (see fig. on the previous page). In the first days after germination, seedlings create long roots. These roots can reach up to 100 mm a week after germination. The plant creates three to four strong roots (Kausch, 2000).

Seed propagation in culture

In nature, service tree means of propagation are complex and in the most part based on the necessity of birds and mammals digesting the seeds, when the seeds' chances to germinate increases due to their passage through the digestive tract. However, it is also possible to successfully grow service trees in artificial conditions. The easiest way is to use the natural dormancy process. At the very start of autumn, by putting freshly extracted and cleaned seeds 2–5 cm deep in soil. In this case, however, the germination isn't guaranteed and depends on weather changes and the incidence of fungal diseases. The first experiments with artificial generative propagation with the use of stratification were made in 1960 in Germany by professor Kausch (Kausch, 2000).

Service tree propagation in folk lore in Moravian Slovakia

"It is hard to grow a seedling from service tree fruit without proper knowledge. When the seeds get eaten by birds and these seeds pass through their digestive tract without damage, they can germinate when buried in soil and give growth to trees. Therefore, it was mainly the birds who distributed the seeds in the area and contributed to the propagation of service trees in the entire southern area of the White Carpathians.

The occurrence of trees older than a century can also be observed at the sites of old horse and cart routes. These locations along the routes aren't arbitrary. We know that the distribution and germination of seeds allows for the passage through the digestive tract, and not only of birds, but also of humans. Therefore we conclude that the reason of service tree distribution before the invention of automotive transportation was that human travellers consumed service tree fruit and subsequently excreted the seeds via the digestive process near roads." (J. Gazda and M. Vítková in Hrdoušek et al., 2003)

In Czech Republic, this area was explored by Forestry and Game Management Research Institute in Kunovice, where the researchers very successfully developed the seed stratification method and conducted seed type selection. Similar methods of propagation were developed in the Department of Fruit Growing and Viticulture of Faculty of Horticulture at Mendel University in Lednice. In generative propagation (using seeds), we need to adhere to the following process. The seeds have to be cleaned of pericarp as soon as possible after the maturation (browning) of the fruit. If the seeds are left in fruit for a longer time, they rapidly lose germinability. First, it's best to mechanically separate the seeds from the fruit. The remaining impurities can be then largely removed in a basin full of water (water will wash away light scales), the rest has to be removed manually after the seed is dry. Dry seeds should be treated with a fungicide (Previcur) or soaked in permanganate solution for a short time (approx. 10 minutes), then dried out and until the time of stratification stored dry in an enclosed package in the fridge at temperatures around 4 °C (Čížková, 1997, Čížková et al., 1999, Benedíková, 2009). It is proven that the seeds can be stored for 3 years at 20 °C without a noticeable decrease in germinability, in the third year, however, there may be a decrease in germinability (Benedíková, 2009).

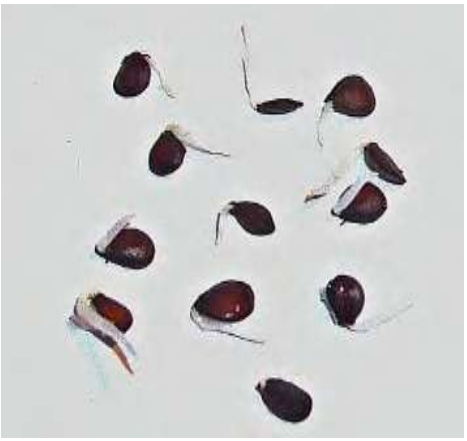
Service tree fruit with seeds (M. Benedíková, 1999).

Service trees replanted into flowerpots at 1 year of age, Forestry and Game Management Research Institute Kunovice (J., 2011).

Stratification and seed germination

Stratification is a pre-sowing treatment of seeds with so-called germination calm, usually done in a dark and moist environment at temperatures around 4 °C (Čížková, 1997; Kausch, 2000; Benedíková, 2009; Drobná et Paganová, 2010; Špišek, 2011). The calm dormancy period is broken due to the lasting lower temperatures and sufficient moisture. The seed then begins to germinate. Due to the high susceptibility to fungal diseases, it's recommended to lay the seeds onto moist filtration paper (or cotton wool) in trays or bowls enclosed in microtene bags. This will allow for regular checks. These should be initially performed every week and should include the removal of empty and damaged seeds (e.g. seeds

infected with mould). The required stratification period varies for service tree seeds of different origin. Kausch (2000) lists the required period of stratification as 10–14 weeks. However, Miko et Gažo (2004) have verified by experimentation that the stratification in a box stated in literature (10–14 weeks) is not sufficient. Benedíková (2009) states that the average period should be 13–19 weeks. Špišek (2011) cites the required range as 14–21 weeks, some seeds even germinated after 28 weeks. Moreover, some seeds germinated only in the second year, after sowing. The germination period should correspond to the time of spring sowing, ideally in heated or cold greenhouses or plastic greenhouses (see table) (Benedíková, 2009).



Germinating seeds immediately after stratification (2, 2007).

Sowing locations	Heated greenhouse	Cold Greenhous	Plastic greenhouse	Outside
Beginning of the stratification	The 1st to 5th of Nov.	Around the 15th of December	the 1st to 5th of Januar	Around the 15th of January, firs
Estimated sowing of the seeds	beginning of March	First half of April	beginning of May	half of May

Service tree seed sowing schedule for forestry (Benedíková, 2009).

In laboratory conditions, the germinability of the seeds is usually between 45 to 90% (Benedíková, 2009; Špišek, 2011). Krška et Fialová (1998) state the germinability of the seeds from Yalta as being between 35.3 and 65%. Seeds germinated in a greenhouse reach a germinability of 70 to 90%. Kausch (2000) states that the germinability of stratified seeds is between 60 to 100%. In Slovakia, stratification was researched by prof. Viera Paganova of Slovak Agricultural University in Nitra. In her study, she stratified service tree seeds in pearlite treated with 20% NaClO solution at +4 °C. She also performed seed stratification in a cold greenhouse in a mixture of pearlite and sowing substrate (1:5) at temperatures of –5 to +5 °C. Seeds started to germinate after just 8 weeks of stratification, with 41% germinability. The method of seed germination in pearlite at a stable temperature of +4 °C has yielded only 22% germinability (Paganová, 2007). Authors Benedíková (2009), Drobná et Paganová (2010) and Špišek (2011) agree that the year of harvest and individual specimen genotype influence the germinability of seeds. Germinability of seeds is twice as high in a seed year than in other years. There is also a strong positive correlation between the weight of seeds and their germinability, as is shown in the following table (Drobná et Paganová, 2010; Špišek, 2011). Another correlation, a strongly negative one, exists between the germinability of seeds and the number of seeds in a fruit (Špišek, 2011). Kausch (2000) notes the difference in germinability

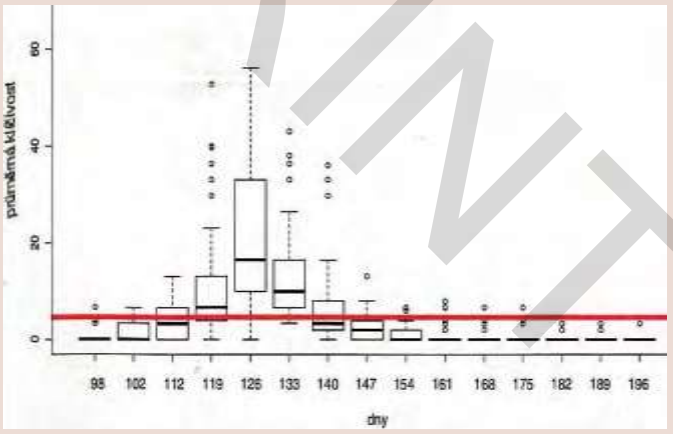
of seeds coming from isolated trees and trees growing next to each other. This finding was confirmed by Miko et Gažo (2004), who discovered that the seeds of isolated trees have a higher germinability compared to trees growing close to each other. Paganová and Bakay (2010) noted the difference of onset of blossoming in different trees in the population, which leads to a decreased chance of mutual pollination.

Location	number of trees on site	average fruit weight (g)	WTS* (g)	average germinability of
Modrá	3	13,0167	34.800	18.5
Jelenec	6	10.7567	31.719	26.5
Čebovice	3	14.2600	34.373	31.0
Príbeničce	2	12.4300	25.325	23.0
Kosihovce	3	16.0900	35.822	71.0
Plachtince	6	7.3600	27.160	6.0

The germinability of the seeds is dependent on the size of the seeds and, by extension, on the size of the fruit (Drobná et Paganová, 2010).

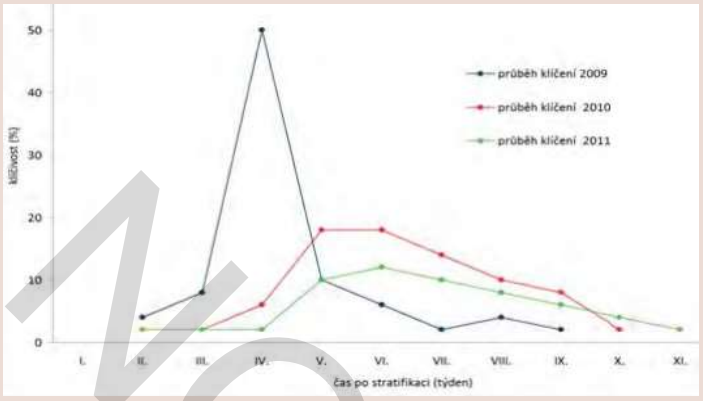
Generative propagation of service trees in the White Carpathians

A total of 1770 seeds from 53 trees were obtained. From each tree, 30 to 50 seeds were gathered. The first service tree seeds started to germinate after 14 weeks (on the 98th day) of cold stratification. The last germinating specimens were observed by the end of week 28 (on the 196th day) since the start of stratification. The germinability of seeds from different trees varied between 33 and 86%. On average, the germinability of seeds that have undergone stratification was 68.54%. The germination period in different observed trees varied between 21 and 84 days. The germination increase occurred between the 112th and the 140th day since the beginning of stratification, as is shown in the graph. During this period, more than half of the monitored seeds germinated. The second graph shows an experiment with seed laying. A sample of 300 seeds was used. 100 seeds of this sample were stratified in 2009, the others were left to lay until 2010 and 2011,



Germinability in time (values over the red line show increased germinability rate) (2, 2011).

*WTS – weight of thousand seeds.



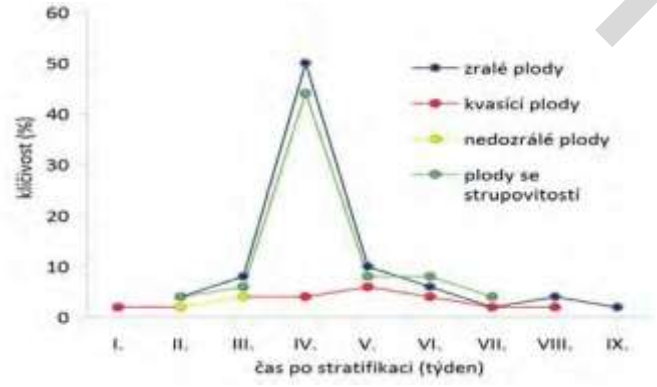
Progress of germinability in seeds that underwent stratification in 2009–2011 (2, 2011).

when they were stratified and began to germinate. Maximum germinability, 86%, was achieved in 2009. In the following year, 2010, the germinability had decreased to 78%. In 2011, a further decrease in germinability could be observed, this time to 58%. In 2010 and 2011, the germination rate was balanced and there wasn't any observed period of increased germination.

Year 2009 can be considered a so-called seed year, when the service tree had had optimal conditions for generative propagation (Špišek, 2011).

The influence of select biotic factors on the germination of seeds

Seeds gathered from ripe undamaged fruit have a maximum germinability of 90%. According to White Carpathian research, the seeds from fruit damaged by scab disease (*Venturia inaequalis*) only evidenced a small decrease in germinability, around 75–80%. The germinability of fruit that has undergone the fermentation process was decreased significantly, only reaching 26%. The largest impact have been observed in seeds coming from dry and unripe fruit. In these seeds, the germinability was only 5% (Špišek, 2011). The chronological progress of the germination in ripe and scabby fruit was similar. It has evidenced an increase in germinability in week 3 to 5, see graph (Špišek, 2011). A weak but balanced progress of germination was observed in fermenting fruit, due to fungal mycotoxins, which was discovered in populations in White Carpathians (see box Špišek, 2011), but also in Germany (Kausch, 2000). The strongest mycotoxins that slow down the germination of seeds in service tree fruit are released by the following families of fungi: *Penicillium*, *Alternaria*,*Cladosporium*



The progress of seed germinability after stratification for various fruit in 2009 (2, 2011).

(Kačániová et Fikselová, 2007). Unripe fruit only germinated in week 2 to 3 (Špíšek, 2011). Seeds taken from unripe fruit have significantly lower germinability due to the effects of acids in the fruit (Miko et Gažo, 2004). The transfer of genetic characteristics (the fruit and seed quality) to progeny was researched by Paganová and Bakay (2010). These researchers have discovered a strong influence of the parent tree on these characteristics (compare chap. XII. 2.), but also on the increment of progeny growing at the same rate, which is an ideal starting position for the selection of suitable genotypes for forestry and gardening.

Seed sowing and seedling care We recommend sowing the germinated seeds individually into gardening substrate in peat-pulp flowerpots with dimensions of 10x10x12 cm. The seedlings grow in these flowerpots for 2–3 months. For further growth, it is ideal to use 30 cm deep black PE bags or flowerpots with similar dimensions. You can add common soil to the gardening substrate used (Čížková et al., 1999). You can also plant pre-grown seedlings in schools in natural soil. In any case, it is

Year old seedling ready to be sown into a patch (2, 2009).

not recommended to sow germinated seeds directly into soil – despite treatment with fungicides, it is impossible to prevent substantial dying off and falling of the seedlings. The seedlings reach 25–30 cm of height on average at the end of the first vegetative period (Paganová, 2007; Paganová et Bakay, 2010; Špíšek, 2011). Benedíková (2009) states that the year old seedlings sown into shaded hotbeds have reached 34.6 cm of height on average (21.4–56.6 cm). Seedlings pre-grown in heated greenhouse can reach an average height of120 cm in the first year and are therefore suitable for sowing on sites. However, during the period of foliage growth, the seedlings must not be exposed to frosts under - 4 °C (Benedíková, 2009).

Seedling cultivation example after three months and after six months in a greenhouse, Forestry and Game Management Research Institute Kunovice (2, 2011).

Two years old service trees in a patch (2, 2011).

Vegetative propagation

In nature, the service tree propagates both generatively and vegetatively. Nowadays, vegetative propagation via suckers (cormoautochory) from the roots of a grown tree is more common in some regions than propagation via seeds (Kausch, 2000). Suckers grow spontaneously in small numbers. If the tree is damaged, affected by necrosis or is cut down, the sprouting capacity of suckers can be high. This characteristic can be successfully used for artificial renewal of service trees. During logging, we use a fence with a diameter of 10 to 30 cm, in which
– if sprouting occurs – the suckers reach heights up to 1 m after the first year (Prudič, 1997). The suckers of unfenced solitary trees in meadows and fields are often damaged by ploughing and cutting, or grazed on by herbivores. Suckers in the undergrowth and hedgerows are more protected. Excessive shade, however, negatively influences the growth and development of the specimen.
The ability of service trees to sprout suckers can be used for propagation via root cuttings (see fig.) For this method, we need parts of the roots from 4–5 year old grown seedlings. During their harvest in the autumn, it's best to dig up as many roots suitable for root cuttings as possible. However, it is necessary to leave enough roots for the mother plant. Cut roots with approximate thickness of 7 mm into cuttings 5–8 cm long. To prevent wrong orientation of the cutting while planting, the cut on the upper side should be perpendicular, while the on the lower side should be oblique. Plant the prepared cuttings into a mixture of peat and sand in

Suckers on an old damaged service tree in Zell am Ebersberg near Bamberg in Germany (5, 2009).

Suckers from damaged roots of a forest service tree on Bídnice (361 m above the sea level) hillside in České Středohoří (2, 2012).

boxes or flowerpots, so that the upper part of the cutting is covered by 2 to 4 cm layer of soil. The boxes are left outside and protected against strong frost by a layer of leaves or fir branches. At the beginning of March, remove the protective layer and transfer the boxes to a warm and sunny site, ideally a hotbed, which will support the sprouting of activated cuttings. Seedlings obtained by this method are usually more balanced height-wise than other seedling (Dagenbach, 1981). According to Benedíková (2009), the success of this method of propagation is dependent on the capacity of individual trees to sprout suckers. Some trees can be propagated via root cuttings more easily than others. This method is problematic in old trees, where it can be difficult to obtain suitable roots. The service tree can be also propagated via stem cuttings. This cutting is ideally removed in the middle of June from young one year old sprouts (branches) or seedlings and should have 3–4 dormant buds and internodium* with the length of 10–15 cm. The cuttings are placed in a mixture of peat and sand treated with fungicide. The cuts have to be treated with a growth stimulant. Stem cuts should be placed at 45° angle into the substrate. Maintain constant moisture. In the first year, the plants reach heights of approximately 30–50 cm (Čížková et al., 1999). It's not common for the cuttings to spontaneously put down roots. Success depends on the choice of suitable substrate.

Root cuttings of a service tree (1, 2013).

Transplantation – grafting

Grafting, or transplantation*, is most commonly used to preserve genetically significant plants. Via grafting, the transfer of monitored qualities can be transferred from a mother tree to new tree. Grafting also allows us to achieve the acceleration of fertility in young trees, as early as in 2–4 years after the intervention. The downside is that the grafted specimen will age faster. Most commonly used methods of transplantation are budding and cleft grafting. The basic prerequisite for the cleft or dormant bud to grow together with the rootstock is to achieve the connection of cambium tissue (meristem) between the rootstock and the graft. We know that only cambium is capable of creating new cells – therefore, the inner surface of the rootstock bark has to connect with the inner surface of cleft or bud bark. The connection of cambium tissues has to be tight and still under pressure.

Ten years old tree grafted onto a terminal sprout, Pilismarót, Hungary (1, 2013).

*__Internodium__ is the part of the stem between individual nodes, i.e. between the places from which leaves, buds or flowers sprout, or in which the stem branches. *__Transplantation__ is the transfer of a part of a plant onto another plant, after which both parts grow together (Nečas et Sus, 2011).

Fertile 8 year old grafted onto a service tree rootstock in Kronberg, Germany (1, 2012).

A precise connection can be achieved, if the cuts on the rootstock and the graft (bud) are made with a sharp knife. Otherwise, the surface of cuts will remain rough and the cambium tissue won't achieve a tight enough connection. The graft has to be tightly joined and the tie has to remain tight until the graft takes sufficiently. The tighter and stronger the connection of the cambium layers, the better are the odds of success. In grafting, polarity has to be respected – grafts cannot be turned upside down on the rootstock. Proper affinity (tolerance) has to be considered as well – only some plants of the same species and family are capable of growing together and create a new tree for the rest of its lifetime (Nečas et Sus, 2011). The cleft graft or bud has to be therefore taken from a healthy, young and fertile mother tree.

Cleft grafting

In cleft grafting, the ideal time to obtain grafts is in February (Benedíková, 2009). The best place to take cleft grafts from is a well-lit eastern, southern or western middle part of the treetop (Nečas et Sus, 2011). This part of the treetop contains annual shoots with sufficient length and thickness, which are also well matured and supplied with nutrients. Store the cleft grafts in cooling boxes with a controlled atmosphere – alternatively, a basement with a temperature of 3–5 °C and sufficient moisture should suffice. The most ideal method of fruit-bearing service tree types is homoplastic transplantation, in which a cleft graft from a fruit-bearing species is grafted onto a healthy plant of the same species. In these cases, a service tree seedling of high quality is used as rootstock. The success rate of such grafts in various years is between 75 to 100%.

Terminal top grafting into a cleft (2, 2009).

In bud grafting, this rate is lower, 68% on average. A high quality seedling from a greenhouse can be grafted at one year of age. For cultivation purposes, it is recommended to cleft graft and bud graft trees of two to three years of age (Kirisits, 2008). One year old grafted plants have achieved average total tree height of 36 cm. Two year old plants have achieved an average total height of 72 cm. One year old grafted plants were 29 cm tall on average (Čížková et al., 1999). Grafting can be done by hand or on site. Grafting by hand is mostly done in schools, often in January or February. The grafted plants then have to be stored in a frost-free room until spring. Grafting on site is performed in favourable

weather conditions from March to the end of April. The grafting is performed by the method of English copulation on flushing rootstock (Kausch, 2000; Hrdoušek et al., 2003; Benedíková, 2009). This method of propagation requires the graft and the rootstock to have the same thickness. On both the rootstock and the graft, make an equally long cut against the bud. Also cut a narrow slice in the third of the graft and the third of the rootstock (see fig. on the next page). In the location of the bud, the plant has the largest amount of stored nutrients, and the

An example grafting of two years old service tree seedlings (2, 2012).

The budding of the service tree is performed on a dormant bud under the bark (M. Ruzicka, 2013).

guarantee of the successful connection is much higher than in other places of both the graft and the rootstock (Necas et Sus, 2011). If the diameter of the rootstock and the graft is small, you can also use cleft grafting (see fig.). Press the surfaces of the cuts together and bind tightly with tape. On the graft wounds, there is a significant evaporation of water from the conductive tissues. These wounds also allow various infections into the plant – therefore, they have to be carefully treated with protective coating.

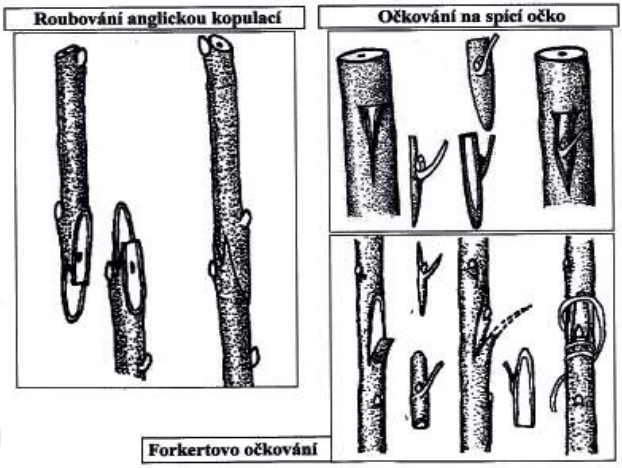
Budding

The budding of the service tree is performed on a dormant bud* under the bark in a period from July to August (Jeszensky, 1986; Kausch, 2000). The budding on a dormant bud is usually performed by the "T-budding" method. A year old seedling is cut immediately before the budding. The seedling has to be well matured. In the lower and the top part of the annual shoot, the buds aren't sufficiently developed. These buds aren't used. After the cutting, the annual shoot has to be defoliated – or, more precisely, we have the remove the leaf blades, the stems remain. The shoot can then be kept for a maximum of 3–5 days in a cold and moist place. Before the budding, remove the side foliage (leaves, branches) from the rootstock, to approximately 20 cm of height.

Budding on a two year old rootstock in Tuln, Austria (Kirisits, 2008).

***Dormant bud** is a part of the annual shoot with the bud in the axil of a leaf. When budding, leave a part of the leaf stem intact.

Budding is performed on the rootstock just above the ground or higher. The bud is placed on the upwind side of the rootstock to protect the graft from breaking away in windy conditions. The rootstock is cut by a grafting knife, first horizontally and then with an approximately 3 cm long vertical cut perpendicular to the first cut downward along the axis of the rootstock,



Grafting methods suitable for service trees (Jeszensky, 1986).

which will lead to a T-shaped cut (see fig.). Slightly peel away the bark with the projection on the back of the knife blade. Then sample the bud from the annual shoot – turn the tip of the annual shoot towards the body, set the knife approximately 1.5 cm under the bud and with one motion, cut out the bud with a shallow cut. The cut should be led approximately 1.5 above the bud. Finally, tear out the cut patch. The cut bud should be narrow. If the cut was deeper, carefully break away the wood and take care not to damage the growth cone of the vascular tissue. It's preferable to cut out narrow buds and not to break away the patch. Afterwards, hold the bud by its sides with your fingers and slide it into the T-shaped cut. Take care not to touch and contaminate the wound. After the sliding of the bud into the cut, cut away the excess part of the tag at the point of the horizontal cut on the rootstock, so the graft fits in properly. Tie the bud with rubber bands or plastic tape, usually bind from the lower part upwards, slide the end under the binding once and tighten in the direction of the bind. Cover the entire location including the bud itself. In two to three weeks, check whether the buds have taken. Well taken buds will have a fresh green colour and the stems will be easily removed. If the stem is still strongly attached, it means it has dried out together with the bud. If the sap still flows, perform grafting on the rootstock again. If the sap stopped flowing, you can perform so-called Forkert budding (Nečas, 2004). Forkert method, also called chip-budding, is performed as follows: instead of a bark cut that we then peel away, cut a thin slice of bark downwards, slightly into the wood. The slice should be approximately 3 cm long and 0.5 cm wide, which is roughly the same size as the bud patch. Leave a 5 mm long tongue on the lower side. Slide the cut bud under this tongue and tie it. The cutting of the bud is similar as in the classic T-budding method, with one exception – the bud is cut in the opposite direction, from the upper side downward, which corresponds to the shape on the rootstock (see fig.). On the lower opposite side of the patch, you can cut the bark into a slightly oblique shape to facilitate better growth with the rootstock (Nečas, 2004).

Cross-species grafting

Fruit growers have long attempted to graft service trees across species (so-called heteroplastic transplantation). In 1804, I. Dubois wrote: "The service tree is grafted on wild types of its species – it also prospers on the pear tree, quince, medlar and hawthorn (whitethorn), but is difficult to graft on apple trees." (Dubois in Moinet, 2009). New research, however, has shown that this method of propagation has only a small significance. Attempts to graft the service tree across species on hawthorn (*Crataegus laevigata*), mountain ash (*Sorbus aucuparia*), Swedish whitebeam (*Sorbus intermedia*), black chokeberry (*Aronia melanocarpa*), medlar (*Mespilus germanica*) and common pear (*Pyrus communis*) were marked with a small success rate. The longest surviving grafts (for 2 years) were on hawthorn and common pear seedlings (Hrdoušek et al., 2003). Other authors (Sus, 1999; Végvári, 1999; Kausch, 2000) using seedlings of mountain ash (*Sorbus aucuparia*), medlar (*Mespilus germanica*) or common pear(*Pyrus communis*) have

Service tree grafted onto hawthorn in Göttingen in Germany after 25 years shows small compatibility of the graft with rootstock (L. Nyári, 2001).

reported similar results; the affinity was very low. Experimental grafting has shown small compatibility (tolerance) between the graft and the rootstock, which resulted in a small success rate

Detailed shot of experimental grafting of Italian service tree clone on quince and mountain ash in 2011 in MEDEL Lednice (2, 2013).

Italian service tree clone graft on quince after 5 years (1, 2013).

and short lifespan of the grafted plants (Benedíková, 2009). However, Stančevič (1986) describes hawthorn (*Crataegus laevigata*) as an excellent rootstock for service trees in all types of soil. He also adds, however, that these service trees grafted on hawthorn are short-lived, which is offset by their early and rich yield. The same author (Stančevič, 1986) further states the following results: pear has poor affinity; quince (seedlings, clone types – MA, Ba 29 etc.) has lower success rate of the grafts (10–15%) and the grafts that have taken have only survived for a few years; mountain ash is described as a rootstock with qualities similar to service trees. Occasionally, some grafted plants are fertile. In Italy near Tierste, the grafted plants (service tree on quince) commonly yield in farmer gardens (see opening fig.). In German Kronberg, a 70 year old graft of service tree on hawthorn, still fertile, was discovered. The tree appeared to be vital and fertile despite visibly leaning to one side due to weaker roots of the rootstock (see fig.).

The outgrowing of the rootstock in Kronberg, Germany, approximately 70 years after the grafting (1, 2012).

Budding the service tree on quince and mountain ash

A new finding gained by prof. Krška of Gardening Faculty at Mendel University in Lednica from Italian growers is the possibility of budding certain service trees onto a quince rootstock Ba 29. The budding material of Italian origin used in September 2012 had a success rate of 100% on 10 rootstocks. The buds have a good affinity of the budded plant and generally appear to be vital (see fig.). Budding with select service tree material (Kronze fruit) from Lednice hasn't achieved such a positive result and the success rate of taking was zero percent. In another budding experiment, mountain ash (*var. Moravica*) was used as a rootstock. Here, the success rate of the Italian clone was 60% on 10 rootstocks. The buds, however, evidenced poor affinity – the leaves on the shoot turned yellow and the increments weren't nearly as large as with the quince rootstock. Despite the unanimously positive results of this pilot study, only the next few years will prove the viability of specimens. According to Benedíková (2009), mountain ash was used as a rootstock in the tests conducted by Forestry and Game Management Research Institute in Kunovice, however, the grafted plants didn't survive for more than three years.

Prof. B. Krška shows the grafting of the Italian clone on quince, MENDEL U Lednice (2, 2013).

Micropropagation

Micropropagation is an alternative method of plant propagation in in vitro* conditions. Regeneration of the plant tissue is affected by cultivation conditions, especially the composition of nutritious media, lightning (quality, intensity and photoperiod), temperature and possibly also the gases in the cultivation environment. Genotype of the specific plant also plays an important role (Šebánek et al., 1998; Šedivá et al., 2013a). Regeneration of the entire plant from sampled cells of the cambium tissue in vitro is performed via organogenesis, during which shoots are created and take root, or embryogenesis, during which a complete plant is created in an artificial environment. The goal is to obtain as many plants of the same genotype and phenotype as the mother plant as possible. In woody plants, this method is based on the multiplication of shoots, which results in a rooted microcuttings (see fig.). This method was honed since the 1960s and is now widely used mainly in China and India.

In vitro culture created from the apex bud of a service tree (J. Šedivá, 2013).

Explantation service tree culture with many shoots in in vitro conditions (J. Šedivá, 2013).

Micropropagation of woody plants

The microshoots are usually grown from the apex or axillary buds cut from the annual shoots of the woody plant. When using these explantations, it is highly probable that the new plants will have an identical genotype (Preece, 1997). This micropropagation method is suitable for the propagation of species with problematic generative and common vegetative propagation (cuttings, grafts) (Tripepi, 1997). This method was successfully used in horse chestnut (Šedivá et al., 2013b) or apple tree (Dobránszki et Teixeira da Silva, 2011), and is commonly used to preserve endangered woody plants.

The cutting of service tree shoot into micro-cuttings for individual cultures (J. Šedivá, 2013).

*In vitro – Latin term meaning "in glass" or "in a vial". This is a sterile environment that has been previously cleaned of microorganisms, which serves for the artificial propagation of plants in nutritious soil from select parts of the plant, so-called explantations.

The success of micropropagation depends on the experience with the propagation process and for most plants includes four phases (Hartmann et al., 2011):

1. The establishment of the primary culture – surface sterilisation of the explantation* and its placing on a nutritious medium to grow into shoots.
2. Multiplication – the production of a culture with numerous shoots.
3. Initiation (putting down roots) – the creation of roots on the microcuttings.

Service tree microcuttings putting down roots (J. Šedivá, 2013).

4. Acclimatisation – the adaptation of the plant to the external environment (hardening of the plants). The establishment and the multiplication of the explantation culture is always done in sterile laboratory conditions. The creation of roots can, however, be stimulated even in non-sterile conditions, depending on the capability of the plant species in question to grow roots. If the roots were put down in a non-sterile environment, the acclimatisation will be easier. The root and the acclimatisation phases are the most challenging phases of the micropropagation process.

Micropropagation of the Sorbus family

In deciduous woody plants, a suitable method of clone propagation is by organogenesis (Malá et al., 1999; Lall et al., 2006). In Sorbus family, the micropropagation method was developed for the service tree (*S. domestica*) (Chalupa, 1983; Arrillaga et al., 1991; Miko et al., 2004; Ďurkovič and Mišalová, 2009; Piagnani et al., 2012), for the mountain ash (*S. aucuparia*) and for the wild service (*S. torminalis*) (Chalupa, 1983; Dujíčková et al., 1991; Malá et al., 2005; 2009; 2011). Prof. V. Chalupa has pioneered the micropropagation method in forest woody plants in the Czech Republic. Among other forest woody plants, this method was also applied to the plants of the Sorbus family. Prof. Chalupa was a part of the collective in Forestry and Game Management Research Institute in Jíloviště-Strnady, which was the first facility in the Czech Republic (and, according to the literary sources available, also in the world) to develop a micropropagation process for the service tree (Dujíčková et al., 1991).

Dr. J. Šedivá shows a service tree culture in vitro (1, 2013).

In the service tree, micropropagation has shown potential mainly because of the possibility of developing cloning material from the trees in fertility phase in relatively large amounts. Organogenesis has

*Explant – a part of the plant, mostly buds in woody plants, that is used for propagation in in vitro conditions.

been found to be the most suitable method for the propagation of service trees, using shoots with the apex-axillary buds sampled in winter and spring periods as a source of plant material (Jámborné et Sinkó, 2005; Nikolaou et al., 2008).

Successful development of explant cultures was achieved, both from young plants in the juvenile phase (Arrillaga et al., 1991) and from mature woody plants that in some cases were around 100 years old (Ďurkovič et Mišalová, 2009). For the purpose of service tree growing in in vitro conditions, MS medium (Murashige et Skoog, 1962) solidified with agar is mostly used. In establishing the primary cultures and shoot multiplication, it is necessary to add growth regulating agents to the medium, especially agents from the cytokinins group. The growth of roots in microcuttings is stimulated in sterile conditions with the presence of growth regulation agents from the auxin group (Malá et al., 2011; Ďurkovič et Mišalová, 2009). Using this method, it is possible to achieve root growth rate up to 80% in microcuttings and

Young service tree plant developed from an in vitro culture (J. Šedivá, 2013).

a 98% success rate of transferring the young plants to normal conditions (Caboni et al., 2009). The transfer and acclimatisation of plants is performed by removing the remaining medium from the roots, replanting the plants into pots with pearlite and keeping them in an environment with 100% air moisture for 4 weeks. Afterwards, gradually decreasing the moisture to allow the plants to acclimatise and harden. After acclimatisation, the plants are replanted into substrate with soil, peat and pearlite content.

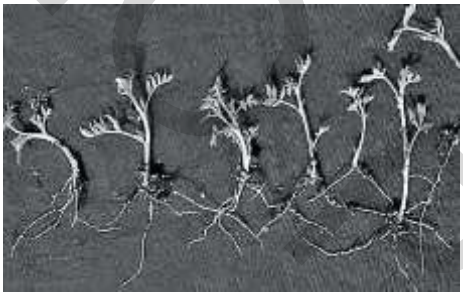
Service tree gene banks in in vitro conditions

In 2012, a collaboration between Silva Tarouca Research Institute for Landscape and Ornamental Gardening (RILOG) and MAS Strážnické Pomoraví, citizens' association was started. In the explant culture laboratory at RILOG, explant cultures (see fig.) from four significant service tree specimens from Žerotín and Tvarožná Lhota sites were established. For the development of the primary culture, apex buds (10–15 mm) sampled in the spring period (April) were used. Sampling and successful culture establishment was also performed for autumn (November), however, a high ratio of microbial contamination of the explants (65%) in comparison with the spring period (12%) has to be counted on. It is possible to have first young plants capable of planting approximately in 18 months after the sampling of primary explants (see fig.).

Initiation of service tree microcuttings in ex vitro

The initiation of the microcuttings is generally the weakest link of the micropropagation method of woody plants propagation, which, in certain tree species, prevents the wider use of micropropagation in school practice. This is also true for the service tree. In warm greenhouse conditions, the botanical garden in Liberec has managed to cultivate young service tree seedlings ex vitro in February–September 2007,

Microcuttings treated with the stimulation powder AS-1 (Prknová et Kobliha, 2009).



Microcuttings 14 days later, in August 2007 (Prknová et Kobliha, 2009).

with simultaneous synchronous creation of roots and acclimatisation. This experiment was performed on a single clone in a series of 30 microcuttings and was repeated 5 times. The outcome was 145 service tree seedlings out of 150 microcuttings (Prknová et Kobliha, 2009). The result of simultaneous initiation and acclimatisation has therefore approached a 100% success rate. For the initiation, a so called semi-warm greenhouse was used. This type of greenhouse has a regulated temperature between 15 °C at night and 20 °C during the day; on warm days, temperatures were approaching 30 °C. It was confirmed that only microcuttings from the laboratory organ cultures could be used (not from natural conditions), once they reach sufficient length for manipulation. In vitro grown axial cuttings with 2–3 cm length (and axillary buds) and apex cuttings are suitable. Initiation was performed with microcuttings flushed with water in non

-sterile conditions with commercially available powder stimulator AS-1 with auxin content (α-napthylacetic acid) and nicotinic acid according to the instructions. The moist ends of microcuttings were once submerged in the stimulator so that the stimulator adhered to them (fig. 1). The substrate used for cutting contained sieved peat and expanded vermiculite in a 3:1 ratio. The substrate hasn't been sterilized in any way. Initially, the cuttings require high humidity – therefore the substrate is filled in a 3 cm thick layer into resealable transparent 18x18x6 cm containers. Fungicides were applied by methods common in gardening, i.e. after the cutting the material was watered by Previcur 607 SL agent in 0.1% concentration. After a week, Topsin M 70 WP was applied in 0.1% concentration via spraying the leaves. From the third week onwards, a gradual hardening against lower humidity was performed by partial opening of the container. The first roots have appeared almost synchronously in 2 weeks after the establishment of the culture. Since then, the plants were being hardened (see fig.). After the initiation and acclimatisation to lower humidity, the plants were replanted into a container in a greenhouse, into a substrate composed of 1.25 l of finely filtered compost soil, 0.25 l of white sand with approx. 1 mm grains and 0.1 of powdered dolomitic limestone for gardening purposes. The seedlings in containers are further cultivated via common gardening and school gardening methods – for the first winter, however, before they turn woody, the seedlings have to be placed into a cold greenhouse with minimal temperature of 4 °C (Prknová et Kobliha, 2009).

VII. 2. Service tree planting

Historically, the service tree was planted as a modest and long lived fruit tree in the entire distribution area along roads, on the borders of fields, and for production reasons in orchards and vineyards. According to witnesses,"the service tree didn't grow by itself", meaning it had to be protected during the first years. It was planted behind hedges to be easily recognizable during felling or hedge cutting.

The service trees were planted in locations that were protected from animals, but once they took root, they didn't require much care (Moinet, 2009). In service tree planting, not only ecological needs were considered, but also the local or cultural significance of the chosen spot. The service tree was planted in significant spots at significant occasions. From the age of the trees (100 years and more) in numerous countries of Middle and Western Europe, we can observe that the last period of purposeful service tree planting as fruit trees was in the 18. and 19. century (France, Germany, Austria, Hungary, Slovakia and Czech Republic).

Certain difficulties in growing the tree from seed and the later onset of fertility in comparison with the newly introduced variants of apple trees, pear trees and other fruit trees around the half of 19. century have prevented further cultivation of service trees in Europe. This has also spread into the wider folk knowledge, which has led to virtual cessation of service tree planting in the 20. century, and the service tree has become an endangered species in Europe.

Comparison of the growth of one year old seedlings in a greenhouse (left) and in a patch (M. Benediková, 2003).

Seedlings

Pre-cultivated seedlings with a height of at least 1.5 m (2–4 years of age) can be planted in nature – in vineyards, biocorridors, in hedgerows etc. Smaller seedlings, approximately 0.5–1 m in height (at least 12 months of age) can be planted in locations where there is a guarantee of grass cutting and complete protection from animals. The most ideal seedlings for planting are seedlings cultivated in containers. These have the advantage of high success rates (the plant doesn't undergo the shock caused by the change of soil and moisture) and the possibility of planting almost

One year old seedlings suitable for plating in protected locations – gardens, yards (M. Benediková, 1999).

Four year old seedling cultivated in a container with a cultivated treetop (2, 2008).

throughout the entire year, with the exception of periods of extreme drought and frost. However, the roots of older seedlings cultivated in containers are usually deformed, which can result in the lack of proper growth for the first few years after the planting. Barerooted seedlings (seedlings without the protective soil around the roots, which are freely inserted in moist soil or sawdust) can only be replanted in humid periods, in autumn (after the leaves fall from the frost) or in spring (after the soil defrosts and the buds sprout). If the root hairs of barerooted seedlings are died out, insert the roots into water for 30 minutes, which will increase their chances of survival. Before planting, check the root tips for signs of damage or crushing. Depending on the results, you can cut the damaged tips or apply tree balm on the bigger wounds. The tree balm treatment is necessary to prevent the infection of the plant by pathogens (fungi, viruses etc.). The ratio of matter above the ground (treetop) and the roots should be 1.5:1 to 2.5:1. Otherwise, it is recommended to trim the part above the ground and apply tree balm on the wounds. The seedling should have undamaged main roots, straight trunk, and possibly also the prescribed number of trunk branches (for 3 year old and older seedlings). The treetop, which should start at 1.8 m height in trees with tall trunk, should generally contain 1 terminal (main guiding sprout) and at least 3 trunk branches. The tree should be free of mechanical damage or disease signs. The planting should ideally be performed in autumn. Planting in autumn is advantageous due to the longer period of calm, when the tree is allowed to regenerate and take advantage of winter moisture in the form of snow. In autumn planting, there is no need to significantly trim the annual sprouts. In spring, a regular watering is necessary. It is also necessary to perform a deeper cut in the treetop, if it's already developed. After planting in spring, the tree should immediately start to grow when the climate conditions are suitable – this, however, also brings the risk of drying out of the roots and subsequently the entire seedling. If you're planting greenhouse seedlings, more care could be required, as these seedlings are more susceptible to temperature fluctuations and diseases.

Where to plant

In the Middle European latitudes, the service tree grows naturally up to altitudes of 600 m above the sea level. This heliophilic and thermophilic tree can be however planted even higher, where there are suitable southern to western slopes and where there is more sun. You can also plant in windy locations with a smaller amount of nutritious soil (clay or skeletal soils) and where other fruit trees (apple and pear trees) wouldn't have grown. Thanks to strong taproots, the service tree can withstand even relatively dry sites and

the tree can usually withstand the force of wind. The strong capacity for putting down roots can be observed in the first year after planting, when the taproot can grow 50 cm deep vertically. The site of permanent planting should be spacious with minimal diameter of 10 m, and it should not be shaded nor flooded. The groundwater level should be deeper than 1.5–2 m.

How to plant

When selecting a plant from the cultivation school, it is necessary to carefully check the seedlings, or to ask for advice. Before planting, you need to dig a pit that is somewhat deeper and wider than the root system of the tree. Place a pole across the centre of the pit and compare the seedling to the pit in order to find out much soil you need to add under the seedling. You can put a handful of slowly decomposing fertilizer on the bottom of the pit, e.g. fruit tree and small fruit fertilizer (with the following content: N 9%, P 6%, K 12% and MgO_2 4%). The fertilizer will provide the necessary nutrition for the first few years of the life of the tree. Never put the fertilizer directly next to the roots, this could easily kill the plant. Fill the bottom of the pit with 15–20 cm high layer of moist mixture of sand and pH-neutral gardening substrate (not acidic peat-based) in 1:1 ratio. The layer of the mixture can also be higher, especially in heavier clay soils. Insert the seedling and cover the roots with the removed soil enriched with this lighter nutritious substrate, which will ease the initiation of the tree.

Carefully plant a hardwood pole next to the tree (take care not to damage the roots) with a diameter of at least 5 cm. Tie the seedling to the pole with a loose tie, so the plant can grow stronger and isn't strangled (see fig.) The mixture of soil and substrate should be firmly, but carefully packed around the roots and continuously moistened with water. Sufficiently packed soil doesn't contain bigger air chambers that would prevent the root hairs from taking root. Immediately after planting, the tree should be generously watered. This watering should be repeated for at least a month when needed, especially when planting in spring months, when the seedling doesn't yet have full roots. Trees planted in nature have to be protected, especially against animals, who destroy 80% of planted trees in the first few years. However, there is no way to completely guarantee protection, since the tree can be grazed upon by mice, hares, bucks, fallow deer and deer. Bucks also often bash their antlers against young trees in protective fence. Moreover, solitary plants in nature are also used as scent trace locations. *Service tree planted on the top of Velká Javorina in White Carpathians at 970 m above the sea level (2, 2012).*

The protection of solitary plant should always include, at the minimum, one supporting pole (diameter at least 5 cm) against the antler bashing of young bucks. The tree can be loosely but firmly wrapped in a firm foil with UV filter or a tube (e.g. special rectangular green forestry tube, see fig.) that is firmly fixed to the pole via a wire in at least two places. Never wire the tree itself to the pole. Another way to protect the plant includes three to four poles driven in a symmetrical position around the seedling 10–30 cm away from the trunk. These poles than can be wrapped with hutch fencing affixed with wire. An effective and cheap alternative is using at least two planks, sharpened and carefully driven into the soil (or covered along with the tree) against each another

Young service tree protected by tube preventing grazing by the animals near orchard in Uh. Hradiště (1, 2012).

only 5–8 cm away from the trunk, tied with wire at the top or joint by a perpendicular plank affixed with nails. All of the mentioned methods of protection for solitary plants should reach at least the height of 60 cm (protection against mice and hares) in the garden, or 1.2 m (protection against bucks) or even 1.5 m (protection against fallow deer and deer) in nature.

Coating of the planted trees

Another way to protect the seedlings is to coat the trunk or the protective poles in full height. This method can be used in combination with fencing. It is recommended to coat the trunk with bitter tasting and irritating agent Aversol, in older trees (5 and more years) also with mildly aggressive natural coat Morsuvin. It is also recommended to coat the protective pole with contact stinking substance named Lavanol, which is manufactured from sheep wool and is based on lanolin. These products are commonly used in practical forestry.

Cultivation of the treetop

In the first years, leave the centre terminal to grow stronger – this part of the treetop should always be the highest one. Determine the height of the trunk by cutting the side branches. In service trees, it is recommended to cut the branches and therefore create the treetop in the height of 1.4–1.8 m and create so called “half-trunk” suitable for grafted trees. By cutting the branches in the height of 1.8–2 m, a so called “tall trunk” can be created. This type of trunk is suitable for long lived seed trees. A shorter trunk isn’t recommended due to the size of the tree and the risk of treetop breaking. If the trunk is very weak, leave the trunk suckers (first branches) to increase strength, only removing them after two to three years, also heightening the treetop. Gradually

establish the treetop with three to four skeletal branches. In service trees, the most suitable is a so called continuous treetop type, in which the centre terminal runs along and dominates the entire treetop. By creating this continuous treetop (see fig.), future problems can be prevented, because this type of treetop also prevents its breaking. At the age of 5–8 years you can shape and eventually also widen the treetop via a system of weights (e.g. PET bottles filled with water).

Three years old grafted plant cultivated into a tall trunk with one terminal sprout and side branches in Bořitov, Moravia (2, 2009).

Fruit-yielding 6 year old grafted tree from Italy in the village square in Jenčice in České Středohoří; this tree was cultivated into a short trunk variant, which can be later problematic (2, 2012).

Cultivated 8 years old seed tree with well developed continuous treetop in the main growth terminal in Tvarožná Lhota, Moravia (1, 2005).

Service tree planting in Moravian Slovakia

The planting of service trees in nature was historically performed mainly in the vineyard area in the foothills of White Carpathians, Chřiby, Ždánický les and Pálava.

Since 1990, there were more than 10 000 service trees planted in Moravian Slovakia and the entire SE Moravia. Most of the trees are planted near villages nowadays: in vineyards, gardens, in public spaces, in hedgerows and orchards throughout Moravian Slovakia. Even though this might seem like a high number, we can assume that only approximately 10% of the trees, that is 1000 specimens, will live up to 20 years of age, when the trees stop being threatened in their development. Out of these, perhaps one third can live to 100 years of age, which means 300 great trees that will survive various changes in the countryside and will grace their environment for centuries.

Apple scab disease on service tree fruit in Kronberg in Hessia, Germany (1, 2012).

VIII. 1. Service tree diseases

In their first years, the seedlings can be very susceptible to fungal diseases. In the first weeks after planting into untreated soil, a so-called "seedling neck fall off" can occur. This is caused by the infection of the seedling by *Fusarium*, *Pythium* and *Cylindrocarpon* family fungi. Seedlings in schools are frequently afflicted with canker caused by *Nectria galligena* fungal pathogen (see fig.) (Čížková et al., 1999). The trees grown from suckers or seedlings replanted from nature do not suffer from this canker (Hrdoušek et al., 2003).

The drying off of the end sprouts and side branches is caused by the *Verticillium alboartum* fungus. Another frequent fungal disease that frequently affects the service tree is *Podosphaera leucotricha* which causes powdery mildew in juvenile and adult specimens. In adult specimens, a frequently occurring infection is caused by the *Clasterosporium carpophyllum* fungus, which causes sharply delineated spots on the leaves (Kausch, 2000; Hrdoušek et al, 2003). These fungal infections, however, occur in small concentrations in service trees, and therefore do not have a significant impact on the health of the plant. Adult service tree trunks can be afflicted with other fungi, such as *Laetiporus sulphureus* or *Stereum purpureum*, and also by "honey fungus" of *Armillaria* family, which sends its tendrils into the core of the infected tree and causes it to die in the next few

years. These fungi can also infect other trees through mycellium growth in the soil (Špíšek, 2011).

Drying off of the sprouts caused by Verticillium alboartum (1, 2003).

Trunk canker caused by Nectria galligena fungus (3, 2000).

Laetiporus fungus sporocarp on the trunk and the base of a service tree (2, 2009).

Roots infected by Armillaria honey fungus (1, 2012).

Fungal infection of the service tree by *Phytophora cinnamoni* was observed on the western shores of Italy (Vettraino et al., 2012) and in the forests of eastern Spain. In St. Anastasia under Mount Vesuvius in Italy, fertile service trees are often plagued by mistletoe (*Viscum album*) growths in treetops (Bignami, 2000).

Scab disease on a service tree leaf (2, 2009).

Seedling sprout necrotized by scab diseases (2, 2009).

Root cuttings of a service tree (2, 2009).

Service tree buds in the so-called "mouse ear" stage (1, 2012).

In recent years, both service tree seedlings and adults are most often infected by the frequently occurring *Venturia inaequalis* fungus (see fig.) causing the apple scab disease. Symptoms of this disease include necrotic spots on the leaves of fruit (see fig.). The both sides of the leaves are covered in a brown-green film that, after some time, turns black and creates scabby spots. Strongly necrotized leaves fall off. Scabbing on the fruit also isn't just cosmetic. Due to the uneven growth of infected and healthy tissue, the tissue cracks, which allows other pathogens to penetrate the fruit (Bednář, 1997). Also, the infection of the entire tissue of young sprouts, which then necrotize and die, can present a serious risk for younger trees (3-5 years of age) (see fig.). Infected blossoms and young unripe fruit can also fall off.

The disease may be temporary and is strongly affected by weather conditions. In winter, the fungus hibernates on the fallen leaves and fruit, where it creates the reproduction stage. In spring, it creates pockets with ascospores, which cause the primary infection.

The ascospores start to mature in the "mouse ear" stage of the buds (see fig.) and in 90-95% of the cases, they mature in the bud phenophase (Bednář, 1997). The critical stage lasts 14 days at most. The spreading and the development of the scab disease is supported by warm and rainy weather and temperatures around 17-24 °C. From the half of April to the half of May, fungicides can be used (see the box). Later secondary infection is uncommon (Špišek, 2009). To prevent the spreading of pathogens in the next season, we need to remove the fallen leaves before the start of spring, and early in the spring, when it first starts to be warm (usually around the beginning of April), a preventative spraying should be performed, which can prevent the spreading of the disease from potentially infected leaves. The spraying can be repeated several times during the vegetative season. After the application, the protective agent has to dry and act for at least 2 hours. If the spraying agent isn't left to dry sufficiently and will be washed off by rain, expect a decreased effect. Do not perform the spraying in rain or sunny weather. When using stronger spraying agent concentrations, do not spray even in slightly sunny weather or at temperatures above 20 °C. In case a repeated spraying is needed, it is recommended to spray with a different fungicide with a different active ingredient. If necessary, however, you can repeat the spraying with the same spraying agent. After the application of the spraying agent on a young tree, it is recommended to fertilize the plant with a potassium-magnesium fertilizer. This will improve the condition of the plant and the leaves will gain healthy green colouration. Furthermore, avoid stress and water the plant sufficiently.

Service trees in vineyards and orchards often suffer from the scab disease with increased frequency, because the disease can spread from the surrounding woody plants (apple trees, roses). Solitary trees in fields, meadows and hedgerows suffer from this disease

Apple scab disease on service tree fruit in Tvarožná Lhota, Moravia (2, 2009).

Scab disease doesn't have a significant impact on the germinability of the fruit, but impacts their edibility (1, 2012).

Venturia inaequalis fungus conidium (asexual spore) (2, 2008).

Service tree with bronze fruit doesn't manifest the signs of Venturia infection (1, 2012).

less frequently. In forest trees, the disease spreads more slowly. Fruit of the trees in the forest above Hrubá Vrbka village on the Moravian-Slovakian border haven't shown signs of scab disease despite their environment being thoroughly infected. In the Italian village of St. Anastasia on the northern slopes of Mount Vesuvius, trees are often infected – however, mere 15 kms away, neat the shores at Torra del Greco, there were trees that have shown no symptoms (Bingami, 2000a). Also, some pomologic types appear to be more resistant. Bronze fruit service tree (see fig.) growing on the Mendel University grounds in Moravian Lednice, were completely unaffected by scab disease, even in years with significant infection pressure (Fialová, 1998; Špíšek, 2009). However, grafts from other service trees grafted onto this tree, haven't shown the same resistance to scab disease.

Spreading agents used against the apple scab disease (*Venturia inaequalis*)

Most often, the agents used against this disease contain the following active ingredients: Merpan 80 WG, Polyram WG, Mythos 30SC. According to the experiences from apple orchards, it is best to use Syllit agent for the immediate treatment and the contact elimination of scab disease (recommended concentration of 10 g/10 l of water). The application of this agent has to be repeated after 7 days and the agent can only be used 3 times per season at most. Another possible means to protect the service tree against this fungal disease is to use Score agent (recommended concentration of 20 ml/10 l of water). This product is also efficient against another powdery mildew disease that can be found on most of the plants. A big disadvantage of this particular agent, however, is the long time it takes to absorb the active ingredients (24 hours) without washing off. It can also be only used 3 times per season. Yet another way to protect the trees against this disease is to use Delan agent with contact effect, which prevents the germination of fungal spores. The advantage of this agent is that it can be applied repeatedly (more than 3 times), since the trees do not build a resistance to it. In the case of already infected tree or growth in April-July period, it is recommended to apply Dithane Neotec contact agent with immediate effects. For the complex protection and treatment of the entire plant (including young sprouts, annual shoots etc.), it is ideal to use systemic fungicides with Discus active ingredient (this ingredient is contained in Talent and Baycor agents, for example) (Jukka, 2011).

Service trees, same as pear and apple trees, can also be infected by a dangerous bacterial disease, fire blight (*Erwinia amylovora*). This disease manifests by sudden drying and dying off of the vegetative tops, drying and dying off of the blossoms and a blight of the fruit. The disease is fast-spreading and causes whole branches to dry and die off (see fig.). In just one vegetative season, it can destroy the entire orchard or a parkway. *Erwinia* bacterium is rare in service trees, so far, but several cases were observed in both Hessia (Kronnberg) and Moravia (Bořetice).

Bacterial fire blight on a service tree in Hessia causing entire branches to die off quickly (1, 2012).

VIII. 2. Service tree pests

The main pests damaging service trees planted in forests and open country are animals from *Cervidae* family – bucks, fallow deer and deer. Young trees can be protected against these pests with special coatings with repellent purposes. In longer winters, young trees can be also grazed upon by hares (*Lepus europaeus*) and mice (*Muridae*). In locations with active European water voles (*Arvicola terrestris*), it is necessary to protect the tree planted on the location against root damage with a wire fence basket with the mesh size of 2 cm maximum. The diameter of the basket should be around 1 m (considering the future roots size) and it should be at least 75 cm deep (Špíšek, 2011). Root damage only occurs rarely below this depth. Service tree roots are taproots, which means that the probability of damage decreases with the recommended protection.

Service trees can be rarely attacked by mites, which is also evidenced by the case of three-year old seedlings intended for grafting near Bořitov, which had to be treated against spider mites (*Tetranychidae*) in the first year. As far as the insect pests are concerned, there were cases of live tree wood damage caused by the tanbark borer (*Phymatodes testaceus*) or insects from the *Scolicidae* family (see fig.) (Špíšek, 2009). Palladius (400 BC) writes in his book *De re rustica*: "There are often reddish worms found in its wood". This probably referred to goat moth and leopard moth (*Cossus*, *Zeuzera)*, larvae, which often create paths under tree bark. In young trees, they feed on the core column of the trunk, which subsequently breaks (see fig.).

Roots grazed upon by European water vole (Arvicola terrestris) (2, 2005).

Paths eaten in bast by Scolicidae family bugs (2, 2005).

***Phytophage** – animal living on diet consisting of plants and trees (Hluchý et al., 2008).

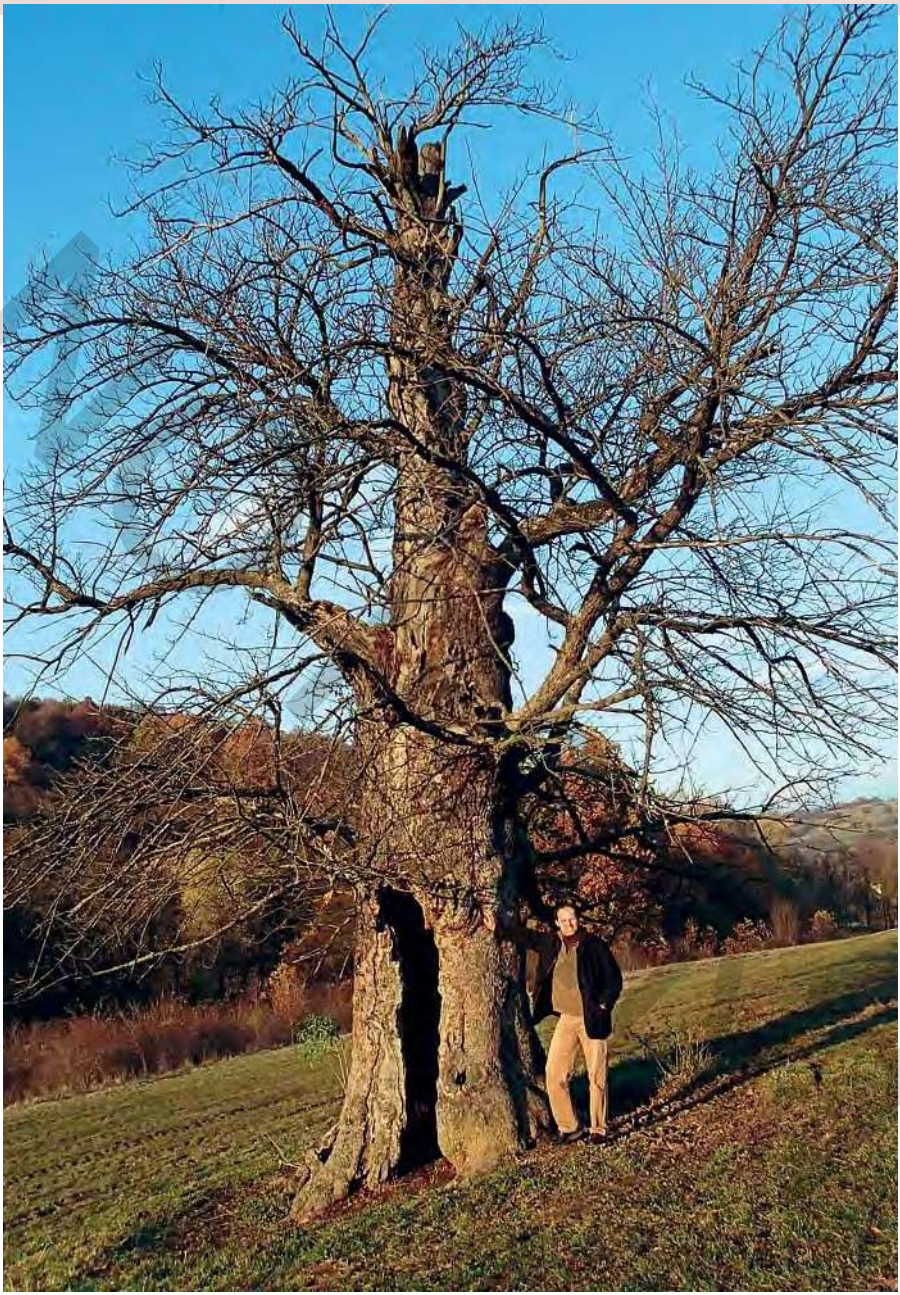
Other insect phytophages* that can be potentially found on service trees:

- Nut leaf weevil (*Strophosoma melanogrammum*) which eats the leaves (Urban, 1999).
- Large shothole borer (*Scolytus mali*) creates paths under the bark and causes the tree to dry off (Horák et Horáková, 2009).
- Pear blight beetle (*Xyleborus dyspar*) creates paths under the bark and causes the tree to dry off (Urban).
- Apple leaf miner (*Lyonetia clerkella*) creates paths in leaves and causes them to dry off (Hluchý et al., 2008).
- Bird-cherry ermine (*Yponomeuta evonymella*) spins cobwebs on the trees in groups and then cocoons (Hluchý et al., 2008).
- Pear midge (*Contarinia pyrivora*) lays eggs in the blossoms and the larvae subsequently bore into young fruit. As the larvae feed, the fruit becomes deformed, blackens and falls off (Hluchý et al., 2008).
- Winter moth (*Operophtera brumata* L.) eats the leaves (Hluchý et al., 2008).
- Grapholita family (*Grapholita janthinana, G. molesta, G. lobarzewskii*) caterpillars feed on the flesh of the fruit (Hluchý et al., 2008).
- *Sessidae* family insects, especially the apple clearwing moth (*Synanthedon myopaeformis*), attacks young trees, create paths under the bark, shortening the lifespan of the tree and p
- ossibly even causing it to die (Hluchý et al., 2008).

Leopard moth larvae (Zeuzera sp.) can cause the entire treetop to break off in young service trees (1, 2013).

Rodents from the Muridae family eat whole fruit along with seeds and therefore prevent the reproduction of the tree (1, 2012).

Bakay et al. (2009) have observed service fruit damage caused by the codling moth (*Cydia pommonella* L.) in middle Slovakia. They discovered the presence of the pest in all of the monitored locations and depending on the occurrence of the moth, they determined an ideal date for picking the fruit in order to gain service tree seeds. This ideal date is one month after the first fruit (significantly damaged by the codling moth larvae) falls



The memorable "Miklo's service tree" in Zlámanec near Zlín, which has undergone a spontaneous treetop reduction (1, 2010).

IX. Service tree – cultivation, tending, and age determination

IX. 1. Cultivation and tending of trees in forests

According to the Summary Report of European Forestry (anonymous author, 2011), the service tree is, along with the black poplar (*Populus nigra*) and the white elm (*Ulmus laevis*), one of rapidly vanishing species with a scattered distribution in Europe. In a number of countries (France, Austria, Switzerland, and the Czech Republic), the service tree is studied as a significant multi-purpose tree for forestry and landscaping (Kausch, 2000; Hrdoušek et al., 2003; Rotach, 2003; Moinet, 2009). Service trees growing in forests can provide good-quality wood from straight trunks of 10–15 m in length (see Fig.). Fruit from forest service trees is a valuable source of food for animals (Kausch, 2000). However, dense and often monocultural forests have been advocated in the past 100–150 years due to intensification of forestry, and the service tree has great difficulties surviving in such conditions. In order to save the service tree in forests, forests rich in other species – the so-called light forests that meet the needs of the photophilous service tree – need to be maintained or planted. Good-quality, at best genetically original planting material, needs to be used for forest planting (Rotach, 2003). Natural regeneration can also be reinforced in forests (Benedíková et Prudič, 2000): enclosing parent trees (the so-called reserved trees) in openings or clearings with a fence in a circle with a minimum diameter of 20 m around each tree.

A massive forest type of service tree (diameter at breast height – 100 cm) grows in Zell am Ebersberg near Bamberg, Germany, and has small apple-shaped fruit (5, 2009)

Service tree near Bad Kissingen, Germany; height 30 m, perimeter at breast height 1.92 m (V. Lippert, 2013).

Service tree in a forest near Comercy, France; trunk perimeter at breast height 2.4 m, height 30.6 m (J. Sisley, 2011).

To protect forest trees *in situ* (i.e. locally), it is necessary to label them well, thin out their surrounding as early as possible, and surround them with a fence with the biggest diameter possible in order to maintain natural rejuvenation. Further thinning out of vegetation follows in subsequent periods as well due to possible rejuvenation by seedlings or suckers. On felling at rotation age* it is necessary to retain parent service trees as reserved trees in clearings. Core population should be maintained in the stand even at the expense of other tree species. Individual trees saved as "stepping stones" can help maintain genetic exchange between populations by pollination (Špišek, 2009). At least 50 fertile trees per 1,000 ha should be maintained in bigger populations. An appropriate approach is to expand the populations by subsequent planting of genetically original service trees into surrounding forest stands. It is optimal to create a network of trees where the mutual distance of groups of service trees does not exceed 3 km. At least one seedling nursery should be established in every suitable region since natural propagation of service trees is minimal. These principles should be promoted in forest management plans of regions where service trees occur (Hrdoušek et al., 2003; Rotach, 2003; Uherková, 2013).

Ex-situ protection of service trees is vital due to their naturally low reproductive ability. Since the 1990s, several seed banks and clone archives of the service tree have been established in Europe. Subsequently, genetic and seed orchards were planted in Switzerland, Austria, Germany, and the Czech Republic. The Czech Republic is at the cutting edge of forestry programmes aimed at genetic preservation of rare woody plants. Forestry and Game Management Research Institute (FGMRI) in Kunovice

The service tree grows and is naturally rejuvenated in open forests near Viterbo, Italy (K. Bačíková, 2012).

Genetic forest orchard in the forest district of Divoky near Zidlochovice, with about 30 service tree genotypes, always in 3 copies (Z, 2011).

*Rotation age – tree stand age in which comprehensive renewal – woodcutting – begins; forest legislation states that the shortest rotation age can be 80 years. Only excessively dense stands may be thinned and cleared before reaching their rotation age.

deals with service tree propagation, mainly in forests of South Moravia (Čížková et al., 1999; Benedíková, 2009). A number of studies dealt with seed germinability and subsequent propagation in the past (Krška a Fialová, 1998; Čížková et al., 1999; Kausch, 2000; Hrdoušek et al., 2003; Benedíková, 2009; Špíšek, 2009). These authors agree that propagation by seed is the easiest and least expensive method of service tree propagation (see Chapter VII. 1. Propagation). The Kunovice FGMRI team under Ms. Benedíková's supervision established a method of service tree seed stratification. The protected landscape area of the White Carpathians was chosen as a model zone for this purpose. From the perspective of propagation, only valuable "plus trees" (Čížková et al., 1999; Špíšek, 2009), which do not fully represent the populations in the area of interest, have been observed there so far. Even big forest nurseries in the Czech Republic (e.g. Lesoškolka Řečany) and Slovakia (e.g. Research Institute of Fruit and Decorative Trees Bojnice) engage in commercial service tree propagation. Genetic resources of *Sorbus domestica* are also maintained in France, Switzerland, Luxembourg, and the UK where the service tree together with the wild apple tree, wild pear tree, wild cherry tree, and wild service are one of the closely watched species within forestry and landscaping programmes, and gene banks have been founded for these species (Rotach, 2003). In-facility protection of the service tree is developed: seeds, pollen, and cell tissues of various genotypes are maintained on a long-term basis in laboratory conditions (Benedíková, 2009).

Cultivating the service tree will probably acquire a new dimension. Thanks to its good adaptability to drought and summer heat not only in the Mediterranean climate, the species is suitable for organic agriculture and afforestation of infertile soils as well as other marginal uses (Moinet, 2009; Bignami, 2009; Paganová et Bakay, 2010).

Reserved trees – approx. 100-year-old service trees, and a service tree seedling in the forest district above Visegrád, northern Hungary (B. Kiss, 2000).

Sorb apples from a forest stand above Visegrád in northern Hungary; diameter about 2 cm, weight approx. 5 g (B. Kiss, 2000).

IX. 2. Cultivation and tending of trees in the open landscape

Solitary service trees above Tvarožná Lhota at the border of Moravian Slovakia (1, 2007).

Adamec's service tree – the largest service tree in the Czech Republic, estimated to be 470 years old, still has a vital full-grown crown (1, 2009).

The service tree has been cultivated for at least 2,000 years as a fruit woody plant. An average tree (aged 30–200 years) growing in the open landscape, without any marks of damage, does not need any special care. Like the walnut tree, full-grown service trees are able to regulate branches that densify their crowns themselves. In young age (below 30 years), it is possible to make basic formative pruning determining the height of the crown and the number of main branches in the crown. The tree's health condition is proportionate to its age. Trees above 200 years of age with rich crowns often have developed medial hollows, which is a phenomenon corresponding to the bionomics of the species, and trees with this handicap can still live for decades (see Chapter X. 1. Wood and bark). The process of ageing or senescence of the service tree comes about, in line with the conditions of the particular location, at 300 up to 500 years of age. Trees can be considered old if they have reached the maximum size of their crown, if it is starting to get dry and gradually becomes smaller. This is the time of spontaneous occurrence of shedding of branches that the tree cannot nurture anymore.The significance of service trees lies not only in their fertility and high age but also in their high aesthetic, biological, and cultural value. An old tree does not lose its value in the landscape.

On the contrary, it creates a living environment for other organisms. Massive crowns and hollow touchwood trunks often create a living environment for rare organisms (insects, birds, mammals, etc.). Old trees co-create rugged or tessellated landscape, which was so typical for the Czech lands in the past. In villages, old trees always used to play a significant role as border points of pieces of land, orientation points in the countryside, meeting places or ancestral trees. Long-lived trees used to be planted on the occasion of childbirth or weddings, and lasted for long generations. From the perspective of genetic diversity, it is also important to preserve at least minimum populations numbering several tens of solitary specimens, and maintain their biotopes in suitable conditions on a long-term basis.

Maintaining service tree population

Tessellated agricultural landscape is vanishing in Europe along with a number of plant and animal species. The service tree is a typical fruit tree of this traditionally cultivated agricultural landscape. Due to the consolidation of pieces of land in the agricultural landscape since the 2nd half of the 20th century, many marginal biotopes (baulks, sides of forests, sunken lanes), the so-called ecotones* that are important for the service tree, have diminished. According to Kellenberger et al. (2003), the minimum size of a sustainable population is 50 service trees that exchange genetic information among each other. Good landscape management should support the survival of fertile trees and follow sustainable numerical as well as age composition for the future. It is vital to preserve and create localities for further planting: baulks, alleys, farm vineyards, pasture orchards, and commemorative places in the landscape (see Fig.). These interests should be taken into consideration as early as when creating landscape or area plans.

At first, it is necessary to identify and preserve a viable core of the local population as a well-functioning biocentre. In the longer term, these cores need to be subsequently interconnected by biocorridors and interactive elements that are purposefully distributed in the landscape on the basis of space and functional criteria in order to maintain ecological stability of the area in the long run. Individual trees in the landscape play a role in this and, like in a forest, they serve as the so-called "stepping stones" for gene exchange. Planting of new service trees in the landscape has to be done is such a way that the replacement of damaged specimens by young trees from local seeds is taken into account. That is why local genotypes are planted locally – in situ. Transfer and planting of local genotypes in one whole ("on farm") are also appropriate, in an environment close to climatically and pedologically natural conditions. Cultivating service trees in orchards and gardens ("on farm" or "in garden")

Planting of a solitary service tree as a symbol of meetings by the chapel near Borotín (central Bohemia) (1, 2013).

Planting of service trees as interaction elements, into an alley in an arable field above Tvarožná Lhota (1, 2009).

***Ecotone** – transition area between two biotopes, e.g. side of a forest, baulk.

A young solitary service tree in Tvarožná Lhota can fulfil the function of a "stepping stone" for the surrounding populations of service trees (1, 2007).

Genetic orchard of 42 genotypes in Pilismarót, Hungary (V. Orsigety, 2013).

A still fertile tree with an open hollow near Kronberg in Hessia, Germany (1, 2012).

should be based on genetic richness of planted service trees in order not to cause degenerative consanguine cross-breeding or self-pollination within the small subpopulation (Boček, 2011).

If a specific woody plant with exceptional characteristics (growth habit, fruit, etc.) is so much endangered that its continuance in the landscape is uncertain, an *ex-situ* preservation method needs to be assumed: transferring grafts or seeds into faraway well-maintained planting areas (Chloupek, 2000). Genetic orchards and alleys are founded in a number of countries in order to preserve various types of sorb apples: The Czech Republic – Průhonice, Holovousy, Lednice, Židlochovice, Tvarožná Lhota; Slovakia – Dolné Plachtince, Geberenica near Zvolen; Hungary – Pilismarót; Germany – Kronberg, Ochtadt; Austria – Oberrusel, Klosterneuburg, Weiden am See, etc. Genetic orchards serve for complementing the genetic material for subsequent propagation and repatriation of trees into original localities (see Fig.).

Resistance and vitality of service trees is evidenced by centuries-old fertile trees with open hollows near Vrbovce, Slovakia, and near Strážnice, Moravia, Czech Republic (1, 2012).

Endangerment of solitary service trees

Every long-lived tree is dependent on the quality of management of its surroundings. Old solitary trees can live only when the landscape is exploited carefully within the concept of sustainable development. Intensive landscape exploitation, such as intensive fertilisation, compaction of soil, close subsoil ploughing, etc. at first leads to a reduction of tree fertility and then to a weakening of physiological processes, development of diseases, and consequently drying of the whole tree. A threat to a large tree's life is posed by intervention in the protective zone of the tree, i.e. the area corresponding to the diameter of the width of one and a half crowns. The condition of the crown points to the state of the root system. Damage caused by subsoil ploughing in the protective zone of the tree is manifested by drying of end branches and subsequently entire branches in the crown (see Fig.).

Drying crown of a service tree signalizes root damage by ploughing. Tvarožná Lhota, Moravia, Czech Republic (2, 2009).

Minimum living conditions for the tree can be provided by grassing its protective zone (Hrdoušek et al., 2003).

Service trees and socialisation of rural areas

Socialisation of rural areas in the 1950s meant a downright disaster for service trees when a number of trees in Moravia fell victims to baulk ploughing. A beautiful service tree was killed in the park of Strážnice, Moravia, when the Bludiště stadium was being enlarged. A similar situation happened in Sidonie near Broumov-Bylnice when building cottages or in Chrastěšov during the construction of family houses. This period is also documented by an advertising photo.

Jak ukazuje úvodní obrázek našich pohlednic z Moravy, mění se její tvář skutečně zjizučným tempem: není čas plout se s jednotlivostmi. V Trnávce spěchají s melioracemi, proto vyhazují srby do vzduchu dynamitem — a jak vidíte, není to nikterak jen mužská záležitost.

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The second threat to lives of large solitary trees is the possibility of breaking of the crown. Most Central European service trees growing freely in the landscape and whose age is above 100 years These trees, often already with medial hollows, cannot withstand the wind and break in two (see Fig.). Another limiting factor is biotope quality in an urbanised environment. Despite the fact that the service tree is a resistant species, its vitality in towns and cities is restricted by soil contamination by de-icing salt, soil compaction and covering by concrete or asphalt, mechanical damage of the trunk and roots, and last but not least, inappropriate treatment of the trunk and the crown. The service tree can survive such an environment, which is evidenced by a still fertile tree about 130 years old, planted in Brno in front of the first gardening college in those days, founded in 1866 (today's School of Art, no. 85 – see Fig.). The bark of the trunk and branches is considerably resistant to damage caused by frost. Frost damage can occur when the bark is injured. Such damage of the trunk need not be manifested by damage of the crown but fungal diseases may come into play (Špíšek, 2009). Insufficient maintenance of the tree's surrounding is also limiting.

Broken dichotomous crown of a service tree above Knězdub (2, 2009).

Hero tree – service tree from Brno awarded as "Tree of the year 2010" (2, 2010).

Dry and drying service trees, both damaged by intensive ploughing up to the trunks of the trees above Kněždub na Moravě (2, 2009).

A wound created after breaking of part of a low crown of the service tree above Kněždub (2, 2009).

Solitary trees in overgrown hedgerows have worsened conditions for dissemination (Benedíková et Kyselá, 2001). Dense undergrowth increases humidity and aggravates the health condition of old specimens. Seedlings and suckers in the undergrowth have a minimum possibility of growth, which is caused by constant shading. Solitary trees overgrown by undergrowth need to be released, and dry branches removed. By releasing trees, humidity gets reduced in the undergrowth along with the risk of infestation with pathogens, particularly fungi.

IX. 3. Tending old trees

Pruning branches

Pruning of branches needs to be conducted in a professional and purposeful manner. Formative pruning is used for young trees. In order to create a crown, one branch for the purposes of the terminal shoot and 3–4 secondary skeletal branches should be chosen. The cut should be done in such a way that the central terminal shoot is longer than the skeletal branches by 10–15 cm (Nečas, 2004). Skeletal branches should always be shortened to an outer bud. In young trees, formative pruning serves for removing competing branches (forks), shoots with overgrown bark, interlacing branches creating whorls, and dead and damaged branches (see Fig.). It is necessary to remove dry, broken or partially broken branches because of protection against fungal diseases. It became clear that a damaged service tree coped well with both rejuvenation

Basic shaping of the crown (cuts marked in red) of a young tree with a terminal shoot, Valtice (2, 2009).

pruning to maintain fertility and recovery pruning to maintain good health condition of the tree even at an old age. Each larger limbing of the crown needs to be done during dormancy (end of February to the beginning of April). If not essential, the crown should not be shortened by more than 5–10 % of its volume so that assimilation (breathing and photosynthesis) is not interfered. New suckers grow even from branches several years old and also from the trunk (see Fig.). Healthy branches of a bigger diameter (approx. 15 cm) should not be pruned since the creation of calluses is limited, and overgrowth of scars is a long- term process.

Rejuvenation of a service tree from the trunk, Strážnice (2, 2007)

Branches with bigger diameters should be pruned multiple times so that they do not get broken due to their weight. A well-conducted, smooth cut is of fundamental significance for quick healing of the wound. Using power saws for branches of a diameter less than 6 cm is totally inappropriate; additional treatment of cuts in branches with big diameters is essential to achieve a smooth and clean surface. Opinions on chemical treatment of wounds vary. However, avoiding it is not considered a mistake (Nečas, 2004).

Conservation of old service trees

The process of ageing, manifested by spontaneous drying of branches in the whole crown of an old tree, need not mean its rapid deterioration but a comparatively long period in the mature tree's life when it is prone to damage and diseases. Drying of terminal branches can only point to the fact that roots are exposed to danger. The proposed interventions have to stabilise the tree and at the same time respect its physiological functions as well as the needs of dependent organisms.

The main goal is to preserve the tree's life and ensure safety in its surroundings. Service trees require a specific approach so it is necessary to entrust their treatment into the hands of professionals. The conservation of old, often memorable trees has to be done by an expert, a trained arborist. Prospective unqualified intervention can do more harm than good. Conservation pruning represents the basic conservation method. The purpose of this pruning is gradual lowering and relieving the weight of the crown in several steps so that the centre of gravity of the tree is lowered and its stability maintained.

Reduction and maintenance pruning of the Vítek's service tree from Tvarožná Lhota, aged about 300 years (1, 2010).

Conservation pruning itself can be divided into reduction, maintenance, safety, and crown pruning. Reduction concerns branches that deviate the tree from its centre of gravity, e.g. trees solely shaded on one side for a long time, or notably tilted trees. Interventions have to support the creation of secondary overgrowth in the lower part of the crown. It is also very important to take into account the tree's natural growth habit when pruning. Sufficiently strong young branches need to be preserved. Generally speaking, branches with at least a one-third diameter in comparison to the branch being removed should be preserved in the crown. Cuts with diameters bigger than 10 cm often get infected with pathogens, which leads to the creation of open hollows. This is why we should use the proposed way, if necessary, to intervene in already infested trees. Reduction pruning should be done up to 10–20 % of the crown volume, and it is desirable to combine it with maintenance pruning. Its purpose is to increase wind permeability of the crown. The upper parts and branches with maximum diameters of 5 cm that densify the crown are removed by this type of pruning. Last but not least, safety pruning needs to be mentioned at this point. Its aim is to secure the crown and remove its broken and dry branches that could create an immediate danger to people's safety by falling or cause damage to property. Crown pruning, used to remove dry or broken branches that are shortened to the length of 50–100 cm, is adopted quite infrequently. The preserved parts of these branches serve as buffer zones for incoming pathogens. The creation of these stubs when lightening the crown supports the natural appearance of the service tree. However, this measure and only if the tree has entered the advanced process of ageing. Moreover, we should never use this procedure to intervene in trees growing in urban areas. If such pruning is done to a healthy specimen, gradual destruction of the tree by wood-decaying fungi can be achieved. Crown pruning is very dangerous and demanding and has to be done by a professional. If possible, all types of pruning should be performed during dormancy – at best in the early spring when strong frosts have passed and new leaves have not budded. Crown architecture is clearly visible in this period. Reserve substances are deposited in the roots or the trunk so removing smaller branches does not lead to significant loss of reserve substances.

Vítek's service tree from Tvarožná Lhota after treatment (1, 2010).

A service tree with skeletal branches broken off by the wind. Protected landscape area of the Central Bohemian Uplands.

The most frequent reason why service trees break is low dichotomous (co-dominant) branching of the trunk that changes into forced branching due to ageing (see Fig.). These problems can be avoided by well-conducted formative pruning in the early years of the tree's life. However, alternative measures such as binding the crown have to be taken when dealing with adult specimens.

A service tree in a field near Dolní Řepčice in Central Bohemian Uplands before (L.) and after conservation pruning (L. Křivánek, 2012).

A split in the trunk (9/2007) and subsequent rupture (7/2009) of Špirudn's service tree in Tvarožná Lhota, Moravia, occurred despite binding of its crown. However, crown reduction was omitted (1, 2009).

The crown of memorable Adamec's service tree reinforced by a rope, Žerotín hill near Strážnice (1, 2013).

Binding the crown with ropes protects skeletal branches from breaking. Static protection of the crown has to be secured by an expert. Binding needs to be done so that protection elements do not grow into branches and weaken them. This process also contributes to the static protection of the service tree by prospective supports (see Fig.). Exclusively non-destructive protection elements (non-drilled binding) can be used for the stabilisation of old service trees.

This protection does not cause mechanical damage of the crown that could lead to infestation of a part of the tree with pathogens (Žďárský et al., 2008). Rope binding has to be loose, unstressed, and needs to let the crown move freely. It only prevents the tree from breaking. It is used for healthy trees without splits and significant hollows in the trunk. The binding is installed in the upper part of the crown above the branching under risk. On the other hand, stressed binding transfers the load into the stable part of the crown by tensile force. Stressed binding is used exclusively when the trunk or branching are damaged by splits, clefts, or hollows. In the past, chains, metal bands, often with tie plates, and also steel ropes were used. Apart from steel plates, harness systems are increasingly employed in stressed and especially in unstressed binding (traditional ropes or hollow pleated ropes made of synthetic materials) today. The selection of appropriate from case to case.

Dichotomous branching of a forest service tree can lead to rupture of the crown (2, 2012).

The suitability and subsequent installation of binding should be reviewed and conducted by a specialised company. Each binding element of the tree needs to be checked visually once a year; binding elements directly in the crown should be checked every five years (Žďárský et al., 2008).

The most natural and oldest method of hollow maintenance is fire conservation. Open hollows that survived fire caused by a stroke of a lightning or human carelessness exhibit great resistance against fungal pathogens. Unfortunately, the tree does not always survive exposure to fire. Moreover, extinguishing smouldering touchwood can last several days. Therefore we should never resort to employing fire as a method of hollow maintenance. Generally, maintenance methods can be divided into mechanical and chemical conservation. Mechanical conservation of hollows means the removal of damaged and decaying wood. In the past, mechanical treatment was done by removing putrescent wood until only healthy wood was left. Today it is already known that there is a so-called reaction zone between the healthy and the damaged wood. If the zone is disrupted, the tree has to expend a great amount of energy to restore it and paradoxically, this way the process gets only worse. Therefore, only the damaged wood that has lost its mechanical characteristics is chiselled off (semi-circular chisels 30–50 cm long are recommended). Chemical conservation of hollows is performed in individual steps. At first, wound disinfection by a suitable fungicide or insecticide is done: Topsin – 0.1–0.2% solution, Fundazol – 0.1% solution, Luxol primer (Žďárský et al., 2008). This is followed by covering the surface with an isolating coating that prevents the formation of pathogens and drying of wood (epoxy resin or Luxol S1012 – only for dead wood). Asphalt coatings used in the past proved themselves to be inappropriate. They often damaged the tree as early as the coatings were

A covered hollow of a memorable tree near Žalhostice in Central Bohemian Uplands (2, 2012).

An open hollow with secondary ingrowth of roots from the crown of a tree in Kronberg, Germany (1, 2012).

applied (hot asphalt killed living cells), and later damage and cracking of the coatings occurred due to thermal expansion. The past habit of sealing hollows was also a big mistake. Concrete or stone seals burden the crown unnecessarily, water gets between the seal and the wood due to tree growth, and creates a living environment for wood-destroying fungi. Bigger hollows where sealing is not possible anymore need to be covered by various constructions and shelters. The most often used materials are natural wood shingles. The following rules should be applied when installing the shelter: drill a hole in the place where the hollow is the closest to the ground in order to prevent it from accumulating water. Leave an aeration hole between the shelter and the hollow so that humidity does not increase in the hollow, and a slightly humid environment with circulating air is created. Wood-destroying fungi do not reproduce in such environment almost at all.

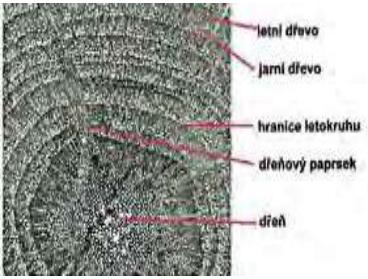
An insufficiently covered hollow of a service tree below Radobýl in Central Bohemian Uplands (2, 2012).

Memorable Karel's service tree and its enclosure with stakes to avoid root damage caused by ploughing (1, 2012).

Tending service trees in the protected landscape area of the White Carpathians

Almost 180 service trees can be found in the protected landscape area of the White Carpathians (Špišek, 2009), and many of them require treatment. Five endangered massive trees have been declared memorable. Comprehensive treatment has been carried out on these and some other specimens: aerated covering of hollows, removal of dry branches, and binding the crown with ropes. Some solitary trees in fields are protected from ploughing.

IX. 4. Service trees and their age



A transverse section of the trunk of a service tree, adapted (Schoch et al., 2013).

Despite its position of a C-strategist*, the service tree can be considered a fast-growing woody plant entering pioneer biotopes with an annual increment of 0.7 m during the first 10–20 years. However, the consequence of this strategy is the rotting of such fast-grown heartwood in older specimens (200 years old and above). Spiral growth of wood around the medial hollow of an old service tree can be observed, which can reinforce the specimen and protect it from breaking.

Sampling wood from the trunk of a service tree by an auger in the White Carpathians at the border of Moravia and Slovakia (P. 2013).

Secondary thickening is unevenly distributed in the whole growth period of the woody plant. Secondary thickening usually occurs much faster in young trees than in older specimens. The basic factors influencing the growth of trees include light, water, length of the vegetation period, content of soil micro- and macroelements, and also characteristics of the biotope such as the angle of the slope, altitude, and geological composition of the bottom layer (Špíšek, 2009). We must consider all these factors when estimating the age of service trees. The trunk diameter of forest service trees at breast height* is generally smaller than the diameter of trees of the same age growing in the open landscape.

The age of woody plants can be determined by several methods. The method of age estimation is the oldest and least precise one. The basic procedure of age estimation involves looking at the tree's dimensions and comparing the age of various trees growing in similar conditions where the age of one of them is known. Another method allows estimating age from historical records (texts, maps, etc.) that state the year of plantation, felling, etc. Tree-ring analysis, based on sampling wood from the trunk using hollow augers, is the most precise method. The diameter of the drill hole is 1–2.5 cm depending on the type of auger used. It is vital to know the characteristics of the biotope in order to determine the age.

***C-strategists –** or competitive strategists are organisms that are highly competitive but able to make use of this capability solely in biotopes that are free of disruption. They often reach large dimensions and abundant biomass, and they are characterised by their longevity and fast growth. Most of their energy is invested into vegetative and storage organs while energy placed into reproduction is low.

***Breast height of the trunk** – the height of 1.3 m above the ground where trunk perimeter is determined using a band. Perimeter at breast height serves as the basic figure for calculating the diameter at breast height.

In a forest near Strážovice, Moravia, the age of service trees was determined to be about 85 years, and it was discovered that a service tree growing on a nutrient-rich biotope reached 21 m in height and 29 cm in diameter at breast height; the height of a service tree on a nutrient-poor biotope was only 12 m and the diameter at breast height was 24 cm. Similar figures pertaining to the age of forest service trees calculated using the trunk diameter at breast height were also recorded in the forests of south-eastern Germany (Kausch, 2000). According to forestry research, their growth

The service tree on the Žerotín hill above Strážnice, dated by a commemorative stone, south-eastern Moravia (1, 2012). A tree with the biggest recorded trunk perimeter – 5.03 m at breast height, Modra, Slovakia (1, 2012).

corresponds to the growth of the oak with a yield class of 2. On the other hand, we also have rare historical data about trees growing in the open landscape. In the vineyards of Strážnice at the border of Moravia and Slovakia, a memorial planting stone with the year 1899 and the inscription that reads "Service tree" is placed by the foot of one of the service trees. The tree's perimeter was 140 cm at breast height (1.3 m), and diameter at breast height was 45 cm in 2003 (Hrdoušek et al. 2003). Its perimeter therefore grew by 1.3 cm on average each year.

In the French department of Sarthe, 600 trees were observed: their perimeter ranged from 1.6 m to 2 m, which corresponds to the age of 150 years and also the period when "service trees were in". A felled service tree's perimeter in La Chapelle-d'Aligné with a diameter at breast height of 1.82 m was 143 years old according to its tree rings. The perimeter of service trees in Sarthe can therefore grow by 1 cm (minimum estimation) up to 2 cm (maximum estimation) each year. Trees with trunk perimeters of 3 m are more than 200 years old, which is evidenced by maps and infrequent measurements. The age of the service tree from Courdemanches is derived from these data too. With its 3.5 m in perimeter, it is one of the most beautiful service trees in Sarthe, and its age is estimated to be 200 to 350 years (Moinet, 2009). In the region of former Czechoslovakia, there is an interesting mention by the Czech Tourist Club from the 1920s: "In the midst of a maze of basalt blocks, an old service tree grows to the east of the Košťálov estate on a place called Kukla. It is 17 m tall and measures 3.5 m in perimeter."

A spring rises underneath the tree and it is taken by a system of pipes into the brewery of Čížkovice." The tree was identified as today's memorable Jenčice service tree (for photo see p. 155) with a trunk perimeter of 3.95 m (Kubát, 2002). Trunk perimeter increment of the tree in the past 100 years is roughly 50 cm.

The most precise method – stone drilling – does not allow determining the age of trees over 200–250 years old because a majority of them are hollow. Hollows appear in all large trees due to the decay of young fast-growing wood, the so-called heartwood (Hrdoušek et al., 2003). The method of age estimation deduced from the trunk perimeter at breast height needs to be used for these trees.

Žlebčík (1999) states that the service tree lives to be 300–500 years old, and 500–600 years in south-eastern Europe if it grows in a suitable place. Likewise, trees in Western Europe can live to be 500–600 years old, and the perimeter of their trunk can exceed 5 m (Bean, 1980 in Kausch, 2000). Our research indicates that the largest trees are found in Central and Western Europe between the 47th and 50th parallels. There are several trees in the vicinity of Kronberg, Hessia, whose perimeters at breast height are over 4 m; the largest tree in Germany that grows in Ochstadt measures 4.4 m in perimeter (Hrdoušek, 2012). Probably the largest tree of France grows in Mavilly-Mandelot near Beaune, Burgundy – its trunk perimeter at breast height is 4.57 m (personal utterance A. Desbrosse, 2012). The largest Austrian tree is located in Gießhübl near Vienna, and it measures 4.52 m in perimeter at breast height. The largest tree of Hungary can be found in the town of Tokay, with a perimeter of 3.8 m. Currently, the most massive living trees are located at the border of the Czech Republic and Slovakia; their perimeters exceed 4.5 m at breast height (1.3 m), diameters are around 150 cm, and their age is estimated to be 400 to 500 years (Čížkova et al., 1999; Hrdoušek et al., 2003). The largest service tree of Moravia, called Adamec's service tree, grows in a vineyard on the Žerotín hill in the White Carpathians near Strážnice. It has a multifid crown about 11 m tall and 18 m wide; the trunk perimeter at breast height was measured to be 4.65 m in 2013. At present, the tree with the biggest perimeter documented is the service tree in a vineyard near Modra in the White Carpathians, Slovakia. The tree reaches the height of 15 m, average width of 12 m, and the trunk perimeter was determined to be venerable 5.03 m and diameter 160 cm during a public measurement event as part of a field trip of the corminaria association.



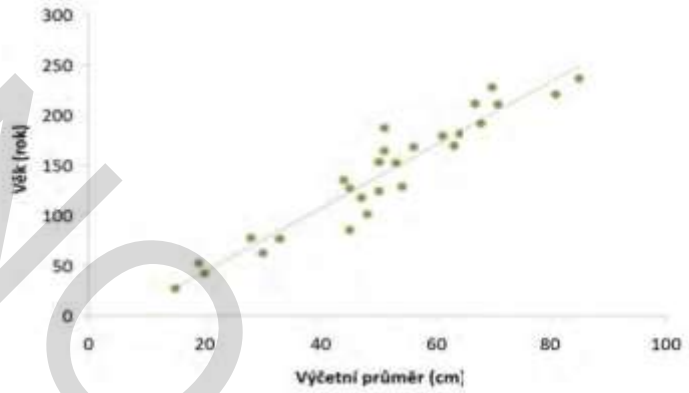
The largest tree documented in France, perimeter 4.57 m, grows near Mavilly-Mandelot in Burgundy (1, 2014); the tree on the Žerotín hill, perimeter 4.65 m (1, 2007); and the tree with a perimeter of 4.4 m in Ockstadt, Hessia, Germany (1, 2012).

Estimations of age according to the trunk perimeter at breast height have also been recently supported by tree-ring analyses. In the White Carpathians at the border of Moravia and Slovakia, sampling of 27 various specimens was performed due to deteriorating health conditions of a service tree population on the hills of Žerotín, Šumárník, and Výzkum, for the purposes of a following tree-ring analysis (Špišek, 2013). Individual samples were taken across the population. The youngest service tree's diameter at breast height was 15 cm and it was recorded to be 27 years old; the oldest service tree measured reached a diameter of 85 cm at breast height and its tree rings pointed to the fact that it was 237 years old. Sapwood was clearly distinguishable from heartwood in fresh samples taken from trees over 52 years of age. We can tell by looking at the following graph showing the dependence of age on service tree's diameter at breast height that the growth of diameter at breast height and increase in age are relatively linear. The trend of the graph lets us estimate that the age of the most massive specimens is approximately 410–430 years. However, this trend need not apply for trees in a senescent stage. Their annual increments are not so recognisable so this estimation is most probably undervalued. Perimeter increments of the largest service trees at the border of Moravia and Slovakia reach 0.5–1 cm each year. The largest trees with perimeters over 400 cm at breast height can therefore be over 400 years old. Based on these measurements, it can be assumed that the largest service tree of the Czech Republic, called Adamec's service tree, may be up to 470 years old, and the age of Mikl's service tree from Zlámanec can even exceed 500 years (see the following table). The influence of the surroundings is very specific and increments very small or notably big, which is enabled by specific conditions of the place. Enormously small increments were recorded in extreme dry conditions, nutritional deficiency, or conditions of rocky biotopes. The age of trees in Crimea, where trees grow in a comparably dry climate and skeletal soils, may serve as an example. Service trees of 70 cm in diameter at breast height are 300 years old or above (personal utterance V. Mezhenskyj, 2012). A unique phenomenon was discovered in Porthkerry Country Park, South Wales, where service trees grow and regenerate on limestone cliffs. The oldest documented specimen has a mere 41 cm in the trunk perimeter at 1.3 m above the ground (and diameter of 13 cm). The age of this

The torso of a hollow trunk of an approximately 250-year-old tree above Strážnice, Moravia, Czech Republic (1, 2007).

The trunk of a tree from a cliff in Porthkerry Country Park near Cardiff, UK (1, 2012).

tree was estimated to be approximately 300 years according to the tree rings of a broken-off branch with a diameter of 6 cm and over 80 tree rings (see Fig.) (Hampton et Key, 1995).



The relation of age and diameter at breast height of service trees on the south of the White Carpathians, Moravia, determined by a tree-ring analysis (2, 2013).

An overview of large and notable European service trees including the determination of their age according to their trunk increment:

** Unless otherwise stated, age is determined by the authors of this publication; images of the trees can be found in this chapter and Chapter VI. Distribution.*

Tree perimeter and diameter at 1.3 m above	Age of the tree, year of	Method of age determinatio	Locality, other data about the tree, mapper
5.03 m, 160 cm	530 years, 2012	estimation, increment comparison	Modra, Little Carpathians, **Slovakia**; state-protected tree, medium-sized apple-shaped fruit, height approx. 15 m. Increment in perimeter: 3 cm every 5 years (2007–2012), perimeter as of
4.65 m, 148 cm	470 years, 2013	estimation, increment comparison	Strážnice, White Carpathians, **Czech Republic**; state-protected tree, called Adamec's service tree, medium-sized apple-shaped fruit. Increment in perimeter: 13 cm every 15 years (1998–2013), 4.52 m, 144 cm (W. Kausch, 1998); 4.62 m, 147 cm
4.63 m, 153 cm	470 years, 2010	estimation	Devičany near Levice, **Slovakia**; state-protected tree, height 18 m, width of the crown approx. 17 m; grows on a baulk above the town,
4.58 m, 146 cm	450 years, 1998	estimation	Zádveřice near Zlín, **Czech Republic**; state-protected tree, measured at 1 m above the ground;

4.52 m, 144 cm	450 years, 1998	estimation	Gießhübl near Vienna, **Austria**; estimated to be 350 years old (W. Kausch et al., 1999; Kirisits, 2007),
4.50 m, 143 cm	500 years, 2012	estimation	Zlámanec near Zlín, **Czech Republic**; Mikl's service tree – state-protected tree on a pasture below the town; dried, hollow, gives fruit only
4.57 m, 145 cm	450 years, 2012	estimation	Mavilly-Mandelot near Baune in Burgundy, in the place of a former estate orchard, **France**
4.5 m, 143 cm	450 years, 1998	estimation	Frankfurt-Bonames, Hessia, **Germany**; estimated to be 200 years old (W. Kausch, 1991).
4.45 m, 142 cm	350–400 years, 1970	estimation (Kausch, 2000)	Virsberg, **Germany**; diameter increment of 16 cm and perimeter increment approx. 50 cm in the past 50 years, perimeter increment of 1 cm
4.4 m, 141 cm	450 years, 2012	estimation	Ockstadt, Hessia, **Germany**; height 17 m, pear-shaped fruit of up to 4 cm (V. Hrdoušek, 2012; V. Lippert, 2013); estimated to be approx. 200 years old (W. Kausch, 2000).
4.25 m, 135 cm	?	cannot be estimated	**Bulgaria**, unknown locality; largest service tree, felled in 1995. Trunk diameter at breast height of yet another largest one is 129 cm
4.2 m, 134 cm	400 years, 2012	estimation	Bošáca-Zabudišová, **Slovakia**; Zicháček's service tree – state-protected tree; height 16 m, fertile tree in a broad valley (V. Hrdoušek,
4.13 m, 131 cm	400 years, 2012	estimation	Kronberg, Hessia, **Germany**; on the edge of orchards (former vineyards), state-protected tree, large fruit; another tree with a perimeter of 4.05 m and small fruit (less than 2 cm) growing nearby in the same locality
4.02 m, 127 cm	400 years, 2012	estimation	Tvarožná Lhota, White Carpathians, **Czech Republic**; Špiruda's service tree – state-protected tree has become a torso, half of the crown was broken off during a gale in 2009; fertile
4.01 m, 127 cm	400 years, 2013	estimation	Aigen near Vienna, **Austria**; hollow fertile tree with a strongly reduced crown, grows in a garden adjacent to a new construction in the place of former

3.95 m, 126 cm	400 years	estimation, extreme location on a scree hillside	Jenčice, Central Bohemian Uplands (České středohoří), **Czech Republic**; state-protected Košťálov service tree; perimeter increment of 50 cm in
3.90 cm, 125 cm	350–400 years	estimation	Velký Ořechov near Zlín, **Czech Republic**; this massive tree originally grew in a vineyard (historical map), today in a garden; the tree has a highly-placed crown – from 5 m,
3.90 m, 125 cm	350 years	estimation (J. Sisley, 2012)	Verger, Marmoutier region, **France**; perimeter of 3.71 m at 1 m above the ground, height 17 m, planted around 1662 ± 80 years, i.e. it is 352 years old ± 80 years; fruit diameter 2–3 cm, apple-
3.85 m, 123 cm	200–350 years	estimation (Moinet, 2009)	Maine-et-Loire, la Sarthe region, **France**; tree with the greatest known perimeter in central France, estimated to be 200–350 years old
3.83 m, 122 cm	300 years	estimation	Mursky Vrh, **Slovenia**; service tree called "Plavecov skorš", cracking twin trunk, pear-shaped fruit (V. Hrdoušek,
3.8 m, 121 cm	300 years	estimation (Bartha, 1996)	Tokay, **Hungary**; the largest tree from a group of 3 fertile trees in the Csöpögő völgy valley (Bártha, 1994).
3.76 m, 120 cm	500 years	estimation (Baznik, 2012)	Brezice, **Slovenia**; the oldest service tree in Slovenia, estimated to be 500 years old (Baznik, 2012)
3.36 m	310 years	historical data (M. Miklánek, 2012)	Bzince pod Javorinou, **Slovakia**; Sapáček's service tree, height 15.4 cm; planted around 1710 (M. Miklánek, 2012).
3.3 m	300 years	torso, 2012	Ferme Weydert, Larochette, **Luxembourg**; 4 trees, the largest one with a trunk perimeter of 3.3 m is a torso, the perimeters of the other trees are 3.27 m and 3.12 m, fertile
3.22 m, 102 cm	200 years	estimation (Djurasevic, 2011)	Loka pri Žusmu, Celje region, **Slovenia**; "Mrázov skorš" is a vigorous service tree, 18 m tall, grows by one of the houses in the village, it is one of the
3.20 m, 101 cm	250 years	estimation, map	Dolní Věstonice, Moravia, **Czech Republic**; memorable tree, border tree growing on the edge of a forest

2.8 m	300 years	estimation (Pirani, 2007)	Predapio, Forlì-Cesena province, **Italy**; "Sorbo del Becco" is regarded as the largest service tree in Italy, estimated to be 300 years old (Pirani, 2007).
2.82 m	205 years	historical data	Němčičky, Moravia, **Czech Republic**; state-protected tree called "Oskoruša Donée", grows by a vineyard, planted in 1809 by a Napoleonic soldier (V. Hrdoušek,
2.67 m, 85 cm	237 years	tree-ring analysis	Hroznová Lhota, Strážnice, White Carpathians, **Czech Republic**; in the place of former vineyards
2.1 m, 67 cm	212 years	tree-ring analysis	Žerotín hill, Strážnice, White Carpathians,
2.1 m, 67 cm	150 years	tree rings of a felled tree	Cormes, **France**; 2 trees felled in May 2005 (E. Moinet, 2009).
2.1 m, 67 cm	150 years	estimation, 2008	Tuileries Cormier in Orne, **France**; observation of growth during 1998–2008: average annual perimeter increment of 1 cm each year
1.8 m, 57 cm	143 years	tree rings of a felled tree	La Chapelle-d'Aligné, **France** (E. Moinet, 2009).
1.67 m, 53 cm	152 years	tree-ring analysis	Strážnice, White Carpathians, **Czech Republic** (Z. Špišek, 2013).
1.54 m, 49 cm	115 years	historical data (planting stone dated 1899)	Strážnice, Moravia, **Czech Republic**; measurement in 2001: 1.40 m, 45 cm, perimeter increment of 14 cm in 10 years (V. Hrdoušek,
1.38 m, 44 cm	101 years	tree-ring analysis	Strážnice, White Carpathians, **Czech Republic** (Z. Špišek, 2013).
1.20 m, 1.30 m,	87 years	historical data (2 trees planted in 1925)	Surfonds, **France** (E. Moinet, 2009).

Forest trees			
2.42 m, 77 cm	210 years	estimation (J. Sisley, 2009)	Commercy, **France**; height 30.65 m, database (NFB) (J. Sisley, 2013).
2.13 m, 68 cm	250 years	estimation, literary data,	Ždánice Forest, Moravia, **Czech Republic**; perimeter of 1.26 m, and height of 15 m were measured in 1912, estimated to be 160–200 years old (K. Chadt,
2.2 m, 70 cm	150 years	estimation (Moinet,	Moriville, **France** (Moinet, 2009); database (NFB).
2.02 m	160 years	estimation (Sisley, 2012)	Forêt du Buchholz in Sarreguemines, **France**; height 32–35 m, age 162 years (± 30 years); photo (J. Sisley, 2012).
1.93 m	120 years	estimation	Bad Kissingen, **Germany**; height 30 m, perimeter 1.88 m in 2008, annual increment 1 cm. (V. Lippert, 2013).
1.85 m	150 years	estimation, stand map	forest by the town of Visegrád, **Hungary**; forest tree with small fruit, height about 20 m
0.91 m, 29 cm	85 years	stand map	Strážovice, forest, Moravia, **Czech Republic**;
0.75 cm, 24 cm	85 years	stand map	Strážovice, forest, Moravia, **Czech Republic**; poor habitat (L. Čížková et al., 1999).
Historical and extreme measurements			
perimeter 5 m by the ground and **7 m at 1 m above**	600 years, 1900	estimation, historical figure	The Horticole magazine called the tree "Géant Cormier" in western **France** in 1990 (Häne, 2002).
0,78 m, 25 cm – diameter at the foot of the trunk	300 years, 1995	estimation, by comparison	Porthkerry country park, Wales, **Great Britain** (Hampton et Key, 1995); 13 cm – diameter of the trunk at 1.3 m above the ground (V. Hrdoušek, 2012).
2.5 m, 70–80 cm	300 years	estimation (V. Mezhenskyj, 2012)	**Crimea**, service trees in a shrub forest (V. Mezhenskyj, 2012).

Interesting information about the age of service trees is provided by scarce forestry data. At the beginning of the 20th century, service trees were used as reserved trees in forests, and their growth parameters were observed (Chadt, 1913; Lieutaghi, 1975; Kausch, 2000). The first photographic documentation of service trees in the region of today's Czech Republic was made in 1912 in the Ždánice Forest close to the Panský vineyard in the forest district of Dambořice, stand 31A, and in the forest district of Kobeřice, stand 26B. In 1912, the trunk perimeter of the service tree near Dambořice was 1.26 m, height 15 m, and it was estimated to be 160–200 years old. At present – a hundred years later – the perimeter of the tree is 2.13 m, diameter 67 cm, and it still gives relatively large conical fruit.

Service tree in stand 31A, Dambořice forest district, in 1912 (Chadt, 1913) and a hundred years later in 2013 with Mr. Typý (J. 2013).

Increments of service trees in Switzerland during 1987–2006

Trunk diameter increment of service trees was observed in the south-western Swiss region of Wetterau. Diameter at breast height was standardly measured at 1.3 m above the ground in 1987 and 2006; diameter increment in millimetres in the course of 19 years was measured in 6 selected service trees (n = 6). Measurement was done using a forester's caliper. That is why minimum and maximum measured diameters for the given year are stated in the calculation. In the course of 19 years, diameter increments of trunks ranged from 1.6 mm to 6.8 mm every year; changes in the perimeter ranged from 0.5 cm to 2.1 cm each year (Werner et Mauer, 2007; adapted).

locality	diameter at breast height	increment *Xχ (mm/year)	characteristics
Butzbach (Schrenzer)	77	8	1.6	damaged trunk
Butzbach	57	6	2.1	dry branches in the
Nieder-Mörlen	52	5	6.8	very healthy
Münzenberg (west)	70	7	3.2	healt
Münzenberg (east)	76	86	2.6	healt
Ober-Mörlen	97	105	4.7	split in the trunk

$$*X_{\chi} = \frac{\frac{X_{min}(1987) + X_{max}}{2} - \frac{X_{min}(2006) + X_{max}}{2}}{19} * 10 \text{ mm/year}$$

Jenčice service tree in Central Bohemian Uplands with a trunk perimeter of 3.95 m is the largest service tree in Bohemia (2, 2010).

Miko's service tree in Zlámanec, trunk perimeter of 4.5 m, estimated to be 500 years old (1, 2012).

Service tree from Hroznová Lhota with a trunk perimeter of 2.67 m and precise age estimation of 237 years (1, 2013).

Service tree from Aigen with a trunk perimeter of 4.01 m, estimated to be 400 years old (1, 2013).

Service tree from Děvičany near Levice with a trunk perimeter of 4.63 m, estimated to be 470 years old (L. Bakay, 2013).

Wine press screw made of service tree wood from 1812, Blatnička na Moravě, deposited in the National Institute of Folk Culture Strážnice (1, 2013).

X. Service tree – utilisation of wood, bark and buds

X.1. Wood and bark

Natural texture of smoothed service tree wood from South Moravia; a detail of unprocessed wood from the Central Bohemian Uplands (2, 2012).

The service tree has one of the most remarkable types of wood. It is distinguished by its hardness and durability, it is resistant to friction, vibrations, and wear. Thanks to these features, it has been used for the production of stress-resistant wooden parts of machines and the production of tools. Like the yew, bay tree, hawthorn, honeysuckle or box tree, the service tree has one of the heaviest woods among European woody plants. Its specific weight is approximately 800 kg/m^3 (Čížková, 1997). Kausch (2000) from Germany claims it to be 880 kg/m^3 and Mathieu from Italy (in Lieutaghi, 1975) states its specific weight to be 810–930 kg/m^3. Its wood is hard, compact but elastic and flexible at the same time. Wood fibres grow spirally with advancing age and the wood is therefore hard to cleave and process on a turning machine. However, it can be polished well; a clean cut can even be polished to achieve the smoothness associated with marble (Lieutaghi, 1975). Spiral growth creates a very decorative effect in the cross section. This forms a unique zigzag arrangement of wood in buttresses, places of forced branching, and often even in the trunk, and this appearance is greatly treasured by cutlers. Wood is bunchy and porous, its growth rings are only hardly distinguishable. Its colour resembles the wood of other species from the *Sorbus* genus. Fresh wood is pinkish, may have a tint of orange, and can turn brown if exposed to air. Dry wood can be brown or brown-red and comparatively dark. Due to its interesting texture, it is often valued in the production of furniture.

The trunk of a 200-year-old service tree with a unique zigzag arrangement of wood; Tvarožná Lhota, Moravia, Czech Republic (2, 2012).

Colour differentiation of heartwood from sapwood is possible only in fresh or steamed wood. Medullary rays are usually distichous, sometimes monostichous (Kausch, 2000). It is very difficult to distinguish between the woods of individual *Sorbus* species (wild service, service tree, whitebeam, and mountain-ash) even using a microscope. Historical remnants of woods belonging to this group cannot therefore be analysed (Kausch, 2000). According to their colour, structure, and texture, woods are well-distinguishable from other *Rosaceae* species, e.g. apple and pear wood.

Wood production and processing

Service tree wood processing was – and in some places still is – famous in the whole region of natural occurrence of the species, especially because of the production of wine presses and mill wheels. Service tree wood felling and its subsequent processing by specialised companies have locally survived in France, Switzerland, and Germany (Kausch, 2000; Moinet, 2009). In the former Austria-Hungary, forest service trees were observed and their parameters measured from the half of the 19th century. Large trees in the forests of the Zdánice highlands that were left as reserved trees have survived in historical records from the Czech lands (Chadt, 1913).

Due to their scarceness, service trees are currently usually preserved in the landscape for a long time until they die naturally. However, such wood is technologically unusable.

A reserved service tree from the forest district of Kobeřice (stand 26B) in Moravia (Chadt, 1913).

In Western Europe,especially in France and Germany, if unique forest service trees are felled together with the wild service, pear tree, and apple tree, they are included into one group of wood called *Schweizer Birnbaum* – Swiss pear tree (Kausch, 2000). The best time to cut wood is when it is fresh. It is hard to cut dry wood – even in the era of electric tools (Moinet, 2009). Information about the prices of service tree wood are also interesting. A forestry college book from Saxony (1868) presents information on the prices of service tree wood at that time as follows: "A trunk of a service tree with a diameter of 40 cm at breast height and height of 4 m was sold for 56 florins." For comparison – the monthly salary of a forestry employee was 12 florins at that time. The price of good-quality service tree wood is currently high as well: 1 m^3 cost 1,500 Euro in Germany in 2000 (Kausch, 2000). The wild service and service tree are most often imported to Germany from France. At present, France is the biggest European producer of wood from wild fruit trees (pear trees, *Sorbus* species, wild cherry trees). Foresters from France and other countries aim to incorporate service trees into forestry planting plans again. The re-discovered forestry species is valued for its diversification of stands within forest reproduction today. The INRA institute and the State forest nursery in Aix-les Milles have been studying its propagation (Moinet, 2009). Service trees together with skeletal woody plants have also been planted into mining clearings of forest stands in a number of countries. Deliberate cultivation of service trees for wood in forests and plantations have been tested in Germany, Austria, Switzerland, and the Czech Republic since the 1980s (Kausch, 2000; Hrdoušek et al., 2003; Rotach, 2003). It can be assumed that a growing lack of heavy tropical woods will increase the significance of service tree wood. The quality of the wood and its high price will gradually surely contribute to the productive cultivation of this woody plant in Czech forests too. The introduction of the service tree into forest stands of altitudinal zones 1 and 2 (categorisation for the Czech Republic) will not only increase their biodiversity but also their market value.

Utilisation of wood

In the past, service tree wood was used for the production of wheel toothing in mills or wine press screws because, as one of few types of wood, it can resist high friction, pressure, and vibrations in constructions. Sporadic evidence of such historical tools are found in the whole Central and Southern Europe (Drvodelić, 2003; Moinet, 2009).

The situation is summarised by Lieutaghi: "The service tree was greatly important in the 16th–19th centuries when craftsmen's tools or tools in factories consisted of many wooden parts. Screws (especially the ones in presses), teeth in gearing, cams, and shuttles made of service tree wood were one of the most resistant and durable ones.

Turned objects – from rifle stocks through knife handles to piano parts – were made of service tree wood. Up to the present, the best jack planes have been made of service tree wood too. This wood, much sought-after by wood carvers and cabinet makers, is especially valuable for engravers who can hardly find better wood for their jobs (the box tree's quality can compare to it, but not its dimensions; moreover, it is much more expensive). It is therefore processed in the form of planks 23 mm wide, very meticulously smoothed and cleaned, usually composed of paired planks that provide balance in case of prospective deformations. Such wood enables extraordinarily fine engraving." (Lieutaghi, 1975). A number of statues in Italian rural areas are also made of service tree wood (Bignami, 2008).

Wine press screw made of service tree wood from the late 17th century, Chateau de Pommard (A. Desbrosse, 2013).

Wine press screw made of service tree wood from the 18th century, Salagon Museum, France (4, 2009).

Wheel toothing of the restored mills in la Sarthe, France, is still made of service tree wood (4, 2009).

In her publication, historical use of this wood in the 19th century in France is recorded by Evelyne Moinet: mill wheel toothing, fruit press screws, cattle yokes, rests, holders, vices, and handles of tools for carpenters and cabinet makers, straw rakes, brake sliders (sliding

Iron turbine wheel with teeth made of service tree wood in the hydro-electric power station near Tournus, France.

shoes) for carts and carriages, carriage wheel hubs, shoe moulds and lasts, clock gearing, hay-rake toothing, butcher's blocks and boards, hunting rifle stocks, and occasionally furniture. She also claims that the first printing press letter blocks were made of service tree wood in the Middle Ages. Artillery wheels of service tree wood for coaches from the 18th and 19th centuries can be seen in the Czech Republic in the Museum of coaches in Náměšť na Hané (Špišek, 2009).

Piquettes – knives for cutting paper

Wooden knives called *piquettes* are still used for cutting paper in the paper mills of Bessé-sur-Braye, France. Since the establishment of paper mills in 1870, these knives have been made from service tree wood. Today they are produced by the carpentry workshop of La Chapelle-Huon near Blessé-sur-Braye. Service tree wood is cut into planks 1.9 to 2 cm thick two months after tree felling. The planks can be processed and made into *piquettes* two years after drying. The production has five stages, and three types of knives are made for different paper widths and various numbers of sheets. Each knife is sharpened and hand-tooled. Knives are currently tooled in a meticulous manner – a manner unheard of in the past. Craftsmen working with service tree wood can distinguish between various types of wood quality according to colour: heartwood of nice brown red colour is older and harder than sapwood (wood between heartwood and bast) of sandy brown (Moinet, 2009).

Various types of "piquettes" made of service tree wood designed for cutting paper rolls; central France (3, 2009).

A wardrobe door made of service tree wood in a household in Burgundy (1, 2013).

Historical jack planes wholly or partly (sliding surface, peg) made of service tree wood (5, 2007).

Opalescent texture of furniture made of service tree wood from Germany (4, 2009).

Service tree wood is currently used locally in Germany, Switzerland, northern Italy, and France for the production of sticks, musical instruments, such as harpsichords and bagpipes, in craft joinery and wood-carving, the production of casting moulds, stress-resistant tools, such as jack planes and chisels, and for various other uses – e.g. shafts, ninepins, billiards and bowling balls, rulers, screws, etc. The traditional production of wooden game balls and sharp knives (*piquettes*) made from service tree wood survives locally in France (Moinet, 2009). In the manufacture of guns and rifles in Germany, service tree wood is still in demand for the production of stocks; in butchery, it is used for the production of butcher's blocks and swinglebars for hanging of pigs in some regions (Kausch, 2000; Hrdoušek et al., 2003).



A bread slicing board and a barrel wrench from the half of the 19th century and a new tooth for mill gearing, Chalon-sur-Saône in France (1, 2000).

Boule de fort – "heavy ball"

The service tree has long accompanied people as far as entertainment is concerned too, e.g. a game with a special ball that does not spin around but always goes diagonally. The ball rocks and is pulled to one side along a curved track. The ball used in this game of *boule de fort* was originally made of service tree wood. At present, balls made of ash wood, boxwood or – to the big detriment of players – plastic are used. However, service tree wood is the best since it resists shocks and does not leave any traces. This game is played by groups in the Loire valley that have been associated and organised in a federation. The championship region of Maine-et-Loire numbers 309 associations, 16 of them in Indre-et-Loire, 5 in Loire-Atlantique and one in Mayenne. Very little is known about the origin of this game. In any case, the game has maintained its unique characteristics: the ball is girded by a metal band, it is oblate, and one of its sides – called *fort* (heavy) – carries more load than the other, which makes its manipulation more complicated and the game more interesting. Balls are made in pairs; they are called "two sisters". Too heavy parts are lightened by drilled holes. The weight of a completed "heavy ball" ranges between and 1.5 kg (Moinet, 2009).


A "boule de fort" ball, its production and use on the "Cercle des Peupliers" track, established in 1880 in Morannes, France (3).

A kitchen made of service tree and wild service wood, Germany (5, 1999).

A corkscrew made of service tree wood from Brittany, France (1, 2014)

The handle of a stitching awl made of service tree wood from Moravia (2, 2012).

Various small tools, massage wooden stones, and decorations made of service tree wood at a market in Tvarožná Lhota, Czech Republic (1, 2008).

Utilisation of bark

Service tree bark or leaves are significant sources of tannin (Usher, 1974), which was used for leather-dressing. This is exemplified by older literature: "Hard wood is suitable for turning jobs; the bark is good for leather-dressing. Several types have been known." (anonymous author, 1899).In the past, a dark liquid for dyeing fabrics was extracted from the bark of young service tree wood in the countries of South Europe (www.agraria.com).

X.2. Buds and their utilisation

Service tree buds have clear therapeutic effects so they are used in contemporary gemmotherapy*. This method was discovered for modern medicine in 1952 by Belgian doctor Paul Henry from Brussels who was concerned with phytotherapy. The first extract he studied was made from birch buds. Plants store the most precious substances, which enable them to survive and safeguard their future, in their buds (*gemma*), the rudimentary parts. Bud extracts are therefore full of extraordinarily valuable contents that are not present in any other part of the plant. These extracts contain extremely efficient substances for the human organism - hormones, enzymes, trace elements, etc. Macerates from service tree buds calm varicose veins. They help recover after problems with varicose veins and haemorrhoids. In the long term, they help maintain the function of the venous system. They have positive effects on lymphatic and venous swellings. In mixtures with other herbs, they help cure angina pectoris, atherosclerosis, and cysts. Together with the mountain-ash, they reinforce the defence system and help keep female organs healthy (Podhorná, 2007). Modern French gemmotherapy regards the service tree, or more precisely, extracts from its buds as "significant agents for channelling the function of the venous system where they fight against blood clotting and tone up venous walls" (Tetau in Moinet, 2009).

*Gemmotherapy – a form of medicine that uses tinctures (alcohol-glycerine extracts) made from plant buds

This plant, which is predominantly considered as a "female medicine", is used for problems caused by menopause, venous hypertension, consequences of venous inflammation, varicose veins, and the feeling of heavy legs (Moinet, 2009).

Service tree bud extract generally improves the quality of the circulatory system, stimulates microcirculation, and protects blood capillaries. It also has estrogenic effects so it can be used for female problems connected with hormonal issues (Zentrich, 2007).

Bud extracts increase the defence capability of an organism, improve the function of the central nervous system, and strengthen and clean the organism.

Slightly opened buds are the most suitable for gemmotherapy (1, 2012).

Buds can resist frost and ice (1, 2012).

Flower buds are appropriate for gemmotherapy (1, 2012).

Excessively opened buds (young branches) are not desirable anymore (1, 2010).

Tinctures from buds

Daily dosage of service tree bud extracts: 1 drop per 1 kg of weight, to be divided into 2–3 doses (e.g. a person weighing 90 kg = 3 x 30 drops). At the beginning of gemmotherapy, it is advisable to start with a birch tincture that serves as a preparatory drainage agent for the therapy itself and at the same time for the cleaning of body (Podhorná, 2007).

Tinctures from service tree buds (France Clarins Laboratoriem, Czech Republic - fa Naděje, Slovakia – fa Serafin) (1, 2012).

Service tree products from the border of Moravia and Slovakia (1, 2012).

XI. Service tree – use of fruits

For the most part, people in the countryside no longer eat service tree fruits or use them for food production. Usually, they don't even know if there are any service trees growing nearby. However, there are still some people who know about them and use them – mainly older people living in the countryside. Occasionally, one might encounter service tree fruits in markets in European cities – in Italy, France, Luxembourg, Turkey as well as in the Czech Republic. In Southern European countries (Italy, France, Croatia, Greece), you might still find places with specialised shops and restaurants that offer service tree fruit marmalades, sauces, or liquors; occasionally, there are exhibitions featuring these products. In France, Germany, Switzerland, and Northern Spain, you can still get both an undiluted service tree wine and drinks that are mixtures of this wine and an apple wine or a grape wine. In Central Europe – in the Czech Republic, Slovakia, Hungary, Austria, Germany, France, and Luxembourg – one can sometimes find and taste a unique service tree brandy (Bignami, 1998; Kausch, 2000; Hrdoušek et al., 2003). In his work *De Re Rustica*, Roman scholar Palladius wrote that as early as in the 4th century, service tree fruits were used to make vinegar (Kausch, 2000).

Service tree fruits in a market in Istanbul, Turkey (2, 2006).

Service tree fruits in a market in Strážnice, the Czech Republic (1, 2009).

The fruits are eaten after they mature and mellow (but before they begin to rot) – they should turn brown and become softer and creamy (for more information, see chapter III. 1.). Mature fresh fruits are sweet, juicy, and slightly aromatic, and their taste is reminiscent of pears. Fruits with grey-bronze skin taste like medlar fruits. Dried ground fruits taste like figs (Moinet, 2009). After mellowing, the fruits can be used to make a whole range of products: whole fruits can be used to make compotes, the pulp can be turned into purées, sauces, and marmalades, and its juice can be put into ciders, syrups, vinegars, and wines. These fruits are also used to provide new, interesting flavours – they can be served in fruit bowls, with pasta, and with various kinds of meat (including venison). We have many historical depictions that document these uses. For instance, we know that Romans ate large service tree fruits that had been cooked in wine (Moinet, 2009). The juice squeezed from mature fruits has been used as an additive for a few centuries now – it can be poured into ciders and syrups made from other kinds of fruits in order to clarify them faster, to improve their taste, and to prolong their shelf-life (all of these are consequences of bactericidal and fungicidal properties of the service tree juice). The service tree brandy has been discovered much more recently – people first started making it in the 18th century.

Mature service tree fruit – detail (2, 2007).

Beautifully coloured fruits that are still too firm to be eaten (1, 2012).

Maturing fruits from Slovakia (1, 2012).

XI. 1. Composition and effects of fruits

Service tree fruits are valued for their nutritional value (see the following table) and their healing properties. The latter is the reason why they are still cared for in some places and why there is still at least some interest in them. From a medical point of view, the fruits have a mild diuretic, tonic, laxative, anti-rheumatic, and antipyretic properties; they also act as a source of vitamins and cholagogue, and a strong medicine for digestive problems (Fialová, 1998). Mentions of service tree fruits used as a medicine can be found in documents written in the Ancient Greece and Ancient Rome eras (see the chapter on history). Back then, they were usually used to treat diarrhoea, dysentery, and an upset stomach; they were also used to strengthen the stomach functions (in that case, they were harvested, cut in half, and dried in the sun). Even the first Czech printed herbarium (written by Jan Černý in 1517) mentions the beneficial effects of these fruits: "These fruits represent a good meal for watery stomach and bowels; they cure ailments brought on by fat and wet heat, and prevent the heat from invading the head. They also prevent choking on blood and vomiting caused by chills. They harden a meal if eaten before and soften it when eaten after, because their tartness contracts the stomach." (Černý, 1981) In 1940, H. Leclerc published findings documenting the positive effects of the regular consumption of service tree marmalade (100 g per day) – the fruits help against bowel irritation and persistent diarrhoea. When consumed in reasonable doses, the fruits can help with many such conditions; if one were to eat too much, however, it would lead to acute constipation (Lieutaghi, 1975). Today, service tree fruits are still used in traditional folk healing as a medicine for stomach ailments and diarrhoea, but also for loss of appetite. According to the old documents, diarrhoeas were stopped with dried fruits, whereas fresh fruits were more suitable as a medicine for constipation, since they have a slight laxative effect. Modern medicine, however, has no use for either for them.

Service tree fruits in traditional folk healing

"When I was a boy, I went to Vrbice to spend the holidays with my grandpa. He had a lot of uses for those fruits, from dried ones used as a diarrhoea medicine to fresh ones used for wine clarification. During World War One, he spent a lot of time in Italy, and he claimed that service tree fruits saved his life. I think it cured his salmonella or something like that." (Personal statement of Fr. Michna, 78 years, taken in Podivín, South Moravia, the Czech Republic, 2009.)

Fruits cut in half and dried on a string, Italy (1, 2009).

Ingredients	The Czech Republic	Italy
Water	78 %	73 – 83 %
Sugars (glucose, fructose, sucrose)	13 %	12 – 17 %
Organic acids (malic, tartaric, citric, parasorbic etc.)	0.7 %	0.5 – 0.9 %
Sorbitol*		0.4 – 0.8 %
Vitamin C – ascorbic acid (40 mg/100 g)	0.04 %	< 0.01 %
Cellulose	3.5 %	
Pectins	2 %	2.54 %
Tannins	0.5 %	1.76 %
Proteins	1.5 %	
Mineral salts (Ca, K, P, Mg, I, B, Fe, Mn)	0.8 %	

Ingredients in an average service tree fruit from the Czech Republic and from Italy, ratio stated in % (Staniševič, 1986; Sus, 1999 in comparison with Lieutaghi, 1975; Bignami, 2000a).

Due to the high content of sugar, the nutritional value of service tree fruits is good. Czech fruits contain 78 % of water and 22 % of dry mass, which contains a lot of sugars: fructose (9 %), glucose (3 %), and sucrose (1 %). There are also trace amounts of flavonoids and carotenoids, and also many ingredients with various kinds of vitamins B and provitamin A, as well as some amount of vitamin C. The fruits are also rich in minerals – they contain calcium, potassium, magnesium, phosphorus, boron, iodine, and iron. On top of that, their composition includes a lot of organic acids – malic, tartaric, acetic, parasorbic, sorbic, citric, and others. There is up to 40 mg of vitamin C in every 100 g of the fruits, which is almost as high as contents boasted by most citruses and five times as much as the amounts found in pears and apples. Compared to other fruits of the *Sorbus* genus, service tree fruits have roughly twice as many sugars. Furthermore, service tree fruits can boast a large content of fibre, pectin, and water (Sus, 1999). A similar study carried out on cultivated service tree varieties in and around Naples pointed to slight differences between individual varieties, but confirmed the overall findings.

*__Sorbitol (glucitol)__ is a sugar alcohol named for a place where it was first isolated from – the fruits of *Sorbus aucuparia*. However, it is also present in apples, pears, turnips, beetroots, seaweeds etc. It is easily soluble in water and moderately sweet. When synthesizing sorbose or ascorbate (vitamin C), sorbitol is a key ingredient. In medicine, sorbitol is used as a laxative and a diuretic, and also as a sweetener suitable for diabetics. When produced in industrial conditions, it is made by a reduction of D-glucose in presence of metal catalysts.

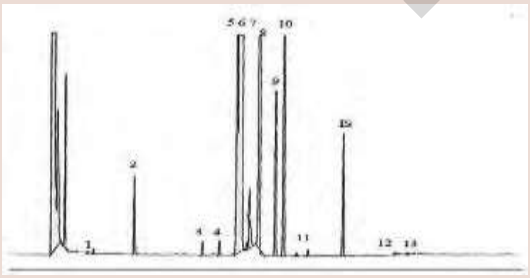
Researchers later carried out another study that focused on organic acids (see the diagram). They found that all fruits contained between 0.5 and 0.9 % organic acids (relative to their weight). In all samples, malic acid was the most prominent one, as it represented between 70 and 90 % of the overall content of fatty acids. Researchers also found a limited amount of succinic and quinic acids (between 4 and 5 % of the overall content of organic acids). However, they found only trace amounts of other acids, such as citric acid or ascorbate (vitamin C). Further analysis revealed a notable amount of sorbitol – between 0.4 and 0.8 mg per 100 g of fresh pulp (Bignami, 2000). In the Mediterranean region, service tree fruits showed higher pectin content (2.54 %), as well as more tannins (1.76 %), at least according to the information provided by Lieutaghi (1975) – it seems reasonable to assume that they analysed fruits that were not mature yet. Furthermore, Lieutaghi found citric, malic, and tartaric acids, which are all important osmotic factors. According to French studies, the tannin content of the juice from not-yet-mature service tree fruits is 20 or even 40 times higher than that of an apple juice (Moinet 2009).

Researchers in other countries also carried out chemical analyses that focused on sugar content, and they reached similar conclusions. In Slovakia, the pulp contained between 9 and 10 % of fructose, between 4 and 5 % of glucose, and only trace amount of sucrose. The pulp had roughly 100 mg per 100 g, or 0.1 %, of vitamins C, E, and B (Májovský, 1992; Pagan et Paganová, 2000; Brindza et al., 2009). In the Nikita Botanical Garden in Crimea, trees of local varieties that are roughly 20 years old produce between 30 and 90 kg of fruits per year – these fruits contain roughly 14.7 % of sugars, mainly fructose and glucose, even though they are quite prone to scabs: on a scale from 1 to 5, they are at 3.5 (Černobaj, 2010). In Croatia, service tree fruits contain roughly 14 % of sugars (10 % of fructose, between 3 and 5 % of glucose, and 1 % of sucrose). According to Croatian researchers, these service tree fruits are extremely rich in vitamin C, which occurs in amounts that rival those of the black currant, which is around 0.15 %- Furthermore, the fruits also feature notable amounts of vitamins A and B2 (Drvodelić, 2003).

Large-fruit service trees in Eastern Serbia produce fruits that weigh 19.4 g and are usually around 3 cm large. These fruits contain 20.5 % of dry mass (or 23.4 % when overripe) (Miletić et Paunović, 2012). In Lower Austria, the dry mass content of dried fruits can sometimes go over 30 % (fruits dried at 115 °C), so they contain less than 70 % of water (Werner & Mauer, 2008).

Ingredients in large-fruit varieties in Italy (Bignami, 2000a).

A chromatogram of acids, sugars, and sugar alcohols in the pulp of service tree fruits: 1 succinic acid, 2 malic acid, 3 – 4 xylose, 5 – 7 fructose, 8 glucose, 9 sorbitol, 10 glucose, 11 inositol (vitamin B8), IS inner standard – control substance phenyl glucopyranoside, 12 sucrose, 13 trehalose (disaccharide).



Ingredients in service tree varieties from the Mount Vesuvius region, Italy (numbers in % of the overall weight) (Bignami, 2000a).

pomol. type	sugars	acids	malic acid	succinic acid	sucrose	fructose	glucose	sorbitol	polyphenols
Panelle	17.34	0.91	0.57	0.020	0.078	9.13	5.68	0.73	0.20
Capitane	11.90	0.54	0.30	0.036	0.050	10.01	4.86	0.42	0.23
Indigenate	17.31	0.63	0.38	0.060	0.108	9.34	5.20	0.67	0.27
Parrocchiane	16.31	0.71	0.54	0.025	0.024	8.98	4.74	0.78	0.23

According to Hungarian studies, the nutritional value is high due to a high content of absorbable monosaccharides and organically bonded metal ions. The cation content of service tree fruits is higher than amounts found in apples or pears. Furthermore, service tree fruits contain 3 or 4 times as much potassium (K+) and calcium (Ca+) (Végvári, 2000). Slovakian studies confirmed these results, but they also showed a surprisingly high amount of vitamin C (Brindza et al., 2009).

Ions	Ion concentration (‰)		
	service tree	the Triumph variety of the pear	the Kovelit variety of the apple
K	**2.629**	1.105	0.894
Ca	**0.450**	0.162	0.113
M	**0.143**	0.067	0.050
P	**0.157**	0.098	0.057
Cu	0.002	0.002	0.002
Fe	**0.009**	0.004	0.003
M	0.001	0.001	0.001
Zn	0.002	0.002	0.002
B	**0.007**	0.002	0.003
Si	**0.006**	0.002	0.002
Ti	0.002	0.000	0.000

Organically bonded metal ions in service tree fruits compared to those found in apples and pears (Végvári, 2000), stated in per mille (‰). The bold numbers represent ions that are more prominent in service tree fruits.

Since a certain point during its maturation, a service tree fruit contains certain acids, pectins, and also sorbitol and phenols that can bind themselves to many harmful substances, relax the digestive system, and have a slight laxative effect (Rotach et al., 2003). On the other hand, service tree fruits contain a lot of tannins that slow the digestive system down and can bind themselves (quite strongly) to water. Tannins can help with diarrhoeas and other infections, such as dismicrobial intestine disorders. Furthermore, tannins are potent astringents, and they have slight healing and antiseptic properties (Lieutaghi, 1975). The presence of the sorbic acid can help slow down the fermentation processes during digestion. The fibre, cellulose in particular, is good for digestive tract motility.

The parasorbic acid, which is present in small doses in every variety of service tree fruits, have a positive effect on bowel epithelium and reduces the effects of toxic substances, which in turn speeds up bowel movement. If the fruits are cooked or dried, this acid loses its properties. However, cooking activates the slight laxative effect in sorbitol. In pharmacology, sorbitol from service tree fruits can be used to manufacture sorbose, which is a sugar used to treat diabetes; it is also employed in cosmetics as a glycerine substitute. Other active substances include pectins that can bind heavy metals – these harmful substances are then taken out of the body and they have no negative effects on your health (Miko, 2011).

Similar studies were carried out in Greece, at the Aristotle University of Thessaloniki, and they showed that mature service tree fruits are potent antioxidants. They also contain important inhibitors – particular flavonoids and phenol acids that are able to postpone the onset of long-term diabetes (Termentzi et al., 2006). Furthermore, these acids and flavonoids have diuretic effects. Since they help to maintain the urinary tract clean, they prevent the formation of bladder stones (Termentzi et al. 2006; Vinklárková, 2010). The seeds of the fruits are similar to other fruit stones – they contain bitter cyanide and their smell is reminiscent of almonds. When drinking improperly made brandy or eating a larger amount of ground seeds, one can become sick. However, trace amount of cyanide can help prevent cancer (Rotach, 2003).

The European Union sees the support of service tree cultivation (with regards to potential dietary uses of its fruits) as an important endeavour – it even incorporated it into its research programs (Bignami, 1998).

Fruits destroyed by mould (1. 2013).

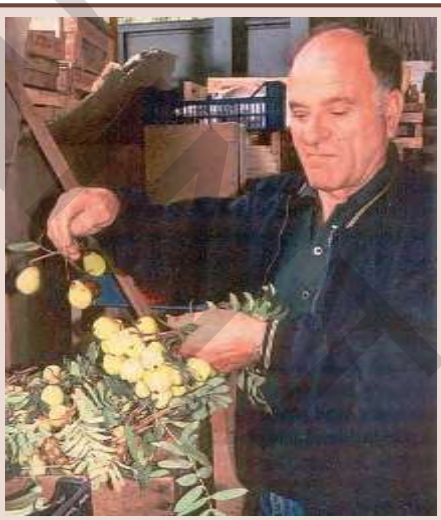
Health risks associated with overripe fruits

When eating overripe fruits, it is best to be careful – fruits might be susceptible to moulds and fungal pathogens. When studying mature fruits with sterilized surfaces, Labuda et al. (2005) discovered the *Cladosporium cladosporioides*, *Alternaria alternata*, and *Penicillium expansum* fungal species, in other words, species that are typically found in rotting produce. Authors pointed out that such fruits might contain mycotoxins. Kačániová and Fikselová (2007) carried out their own study and identified these fungal species: *Alternaria*, *Botrytis*, *Cladosporium*, *Penicillium*, *Mycelia*, *Mucor*, and *Trichoderma*. The *Aspergillus* and *Penicillium* species were indentified as the main source of mycotoxins on service tree fruits.

XI. 2. Harvesting and processing sorb apples

Sorb-apple products from Hungary (1, 2013).

Sorb apples are harvested manually. Fruit of large trees is left to fall off, it is continuously picked and left to ripen (soften and brown) on drying hurdles in half-light at outdoor temperature. Unripe sorb apples intended for the production of fruit wine are knocked down from ladders using poles. Like other types of fruit, sorb apples were considered delicacies and flavouring agents in the past. Fruit was picked from the Middle Ages until the 19th century mainly in rural areas, predominantly from wild-growing trees planted near houses: wild cherry trees, service trees, blackthorns, and pear trees. Fruit was dried and boiled either in sauces or was used soft-boiled to accompany dishes, or ground to sprinkle food (Moinet, 2009; Beranová, 2011). Like strawberries, sorb apples can also be stored frozen so that they are always on hand.



Snapped-off branches being tied up into bundles for sale (Bignami, 2000a).

Sorb-apple harvest in southern Italy

Sorb apples designed for direct sale are harvested manually in intensive plantations of grafted low trees using ladders and baskets. When harvesting sorb apples of large-fruited varieties in southern Italy, whole branches with groups of fruit are pulled down. The daily amount of harvested fruit per one picker ranges between 400 and 500 kg. Branches with fruit are subsequently tied together, placed into boxes and delivered to the markets in the selected cities in the north (Turin, Milan, Bologna). The storage system of sorb apples is traditional: arranging branches with fruit in boxes in a barn, pantry, dry cellar, or shelter. Sorb apples intended for market sale (especially the Indignente variety) are stored in cooling rooms at 5–6 °C where they can last over a month, and are suitable for follow-up distribution. On some farms, trees are pruned after October and November harvests (Bignami, 2000a).

Dried sorb apples

Ripe sorb apples are arranged and dried on hurdles or straw. Formerly, drying represented the most frequent utilisation of sorb apples, and this method has rarely survived in rural areas up until today. Halved or whole fruit is dried on hurdles, sieves, or strings, and desiccated either naturally (in southern countries) or in artificial heat until it is completely hard. Dried sorb apples are traditionally ground or pounded in a mortar and used as a pastry topping (*prachanda*, see fig.). If intended to be eaten directly, they are dried so that they remain soft (like raisins). Whole desiccated sorb apples can be soft-boiled and consumed as compote. Even sweet bread and jam were made from dried sorb apples in southern Poland (Mikolajova, Stoličná, 2004). Good farmers thought of their cattle too: in many regions, predominantly in the Balkans, desiccated and ground sorb apples are still added into hay. Dried sorb apples were given to cattle especially when the animals suffered from diarrhoea (Hrdoušek et al., 2003). Modern household or industrial drying machines can be used for desiccating fruit today.

Moravian-Slovak "pěry" gnocchi with a sorb apple topping and sugar (1, 2009).

Mrs. Vítková from Tvarožná Lhota, Moravia, is serving the "běleše" pastry with the traditional sorb apple topping (1, 2007).

Popular utilisation of sorb apples in Moravian Slovakia

"In earlier times, sorb apples were used for various needs in the household – both in the kitchen and for the treatment of certain intestinal troubles. Sorb apples were desiccated in large numbers for these purposes. They were fine-ground to be used in the kitchen; the powder was added to various dishes because it tasted like cinnamon. Whole dried sorb apples together with other desiccated fruit were soft-boiled and served as compote mostly in winter months. People consumed dried sorb apples in various acceptable forms to fight diarrhoea. Whole sorb apples were given to cattle, especially pigs, in necessary amounts. This effect of the fruit is currently quite overlooked. Service trees have yet another function: they give sweet fruit from which liquor can be produced after fermentation." According to Jan Hořák (aged 64) from Strážnice (31st January 2003).

From an account by Mrs. Vítková (aged 80) from Tvarožná Lhota, recorded on the 2nd Nov. 2002: "…Nobody remembers when it grew to be so large but it used to be even larger. Now it is just old, with broken branches, and totally hollow. The whole village used to come there, to cure themselves from their intestinal troubles. In the past, there were no fences between backyards… and sorb apples were all picked. People harvested mainly the dried ones, and boiled and ate them mainly to cure diarrhoea. The fruit probably also helps fight intestine and rectal cancer if the disease has not developed too much. It was dried in ovens too. When you get diarrhoea, it is enough to drink compote syrup. I learned this from my grandmother, a cousin of painter Frolka. She used to make toppings from this fruit and use it on pastries (*béleše* and *šišky*) and so on. I conserve and dry it but the best sorb apples are the ones that have been frozen. A Mr. Jagoš from Lípov used to take three sacks of sorb apples to produce liquor for a doctor from Brno who used it as medicine."

Teas made of desiccated sorb apples are used to cure the prostate, diabetes, kidney inflammations, and diseases of the gall bladder. The tea is diuretic, antidiarrheal, it eliminates kidney stones, and reduces cholesterol. The recommended dosage according to Termentzi et al. (2006) is two cups per day for a period of 8–15 days. Herbal anti-inflammatory tea with a small amount of sorb apple brandy with honey or just sorb apple brandy with honey taken several times a day in small amounts is appropriate to treat and prevent the cold (Hrdoušek et al., 2003). In Spain, also blossoms are used for the preparation of laxative teas, and leaves in Turkey (Termentzi et al., 2006; García, 2013).

Sorb apple tea from Moravian Slovakia (1, 2013).

Utilisation of sorb apples in Moravian Slovakia

Teacher Josef Bajar (1906–2000) recounts memories from his childhood in Kněždub: "My grandmother used to dry sorb apples in the oven after baking bread. However, it was bad if they got burnt. Sorb apples were called *zápečky* after such preparation – their skin became shrunken and they got even softer. In such state, we loved them the most as children. Drying was slowed down and finished in a cooler oven. Dried-up fruit must not have been too hard, only chewy. It was left to dry up in linen bags after which it was so hard that it rumbled as nuts. Dry sorb apples were pounded in mortars or wooden pounders. *Pěry* gnocchi or drop scones with a cottage cheese topping were sprinkled by sorb apple powder instead of cinnamon. Alternatively, dried sorb apples were simply boiled in sweetened water and eaten as such. Powder as well as boiled fruit can really stop diarrhoea and regulate the stool." (Tetera, 2006)

Mr. Bajar with his student by the school service tree in Hroznová Lhota (anonymous author, 1980s).

Sorb-apple juice, pulp, and compote

Preserved sorb apples at the Service Tree Festival in Strážnice in 2005 (2, 2005).

Approximately 50–60 l of must can be obtained by de-juicing 100 kg of ripe soft sorb apples using an ordinary press (Hrdoušek et al., 2003; Miko, 2011). Fresh sorb-apple juice stored in a cool place is used for treating indigestion at 100–200 ml per day. Thickened syrup is prepared by evaporating water from juice boiled to 80 ˚C, followed by adding fructose and ascorbic acid. At the border of Moravia and Slovakia, sorb apples have been used to prepare home-made jams, compote, fruit purée, jelly, and as additional ingredients in fruit juice. Kausch (2000) mentions sorb-apple compote that is currently sold in German pharmacies as a medicine against intestinal diseases. Coulon (1986, in Moinet, 2009) states that this fruit was known only in French rural areas where children get accustomed to its taste from early childhood, and also mentions sorb-apple compote that is available in some pharmacies. Jam reminiscent of the flavour of quince jam is prepared from sorb apples (it is great to combine them with apples in the ratio of 1 : 1) in the countries of former Yugoslavia (Drvodelić, 2003).

Products from sorb apples in Moravian Slovakia (1, 2007).

RECIPES from sorb apples

Sorb-apple juice (E. Moinet, France)

Sorb-apple juice can be prepared by pressing ripe fresh or boiled fruit. Hot juice (or just heated in case of fresh sorb apples) is filled into glass bottles with screw caps. This way, juice can be stored for several months up to a year. Jelly or syrup can be prepared from pressed juice too. The material left after pressing – skin and pulp – can be ground; this is the basis for the production of liquor. Sorb-apple juice (0.5 kg) is mixed with 0.5 kg of honey. This potion is used in small doses for refreshment and strengthening of the body (D. Drvodelić, Croatia).

Sorb-apple pulp (E. Moinet, France)

Choose soft, ripe, browned sorb apples in order to extract fruit pulp. Place washed fruit into a pot, pour some water, bring to boil and simmer for 10 minutes. Strain boiled fruit in a vegetable mill or liquidise it in a food processor. Add boiled water to make the pulp thinner. Pulp is the basic ingredient for most of the recipes by Evelyne Moinet.

Sorb-apple jam (E. Moinet, France)

Melt 1 kg of sugar in 1 glass of lukewarm water until you reach a syrupy consistency. Mix 1 kg of hot sorb-apple pulp with the sugar solution and juice pressed from a half of a lemon. Heat for 15 minutes and stir occasionally. Bottle.

Sorb-apple jam from the French village of Cormes.

Preserved sorb apples (M. Vítková)

Put ripe washed sorb apples into preserving jars, sprinkle with two table spoons of sugar, pour water and sterilise for about 25 minutes at 80° C.

Sorb-apple jam (L. Polášková)

Ingredients: ripe sorb apples, gelling sugar, water, optionally rum, cinnamon, lemon zest or juice.

Soft-boil sorb apples in a small amount of water and strain. Add gelling sugar into the pulp in line with the instructions on the package, flavour the mixture with rum, cinnamon, and lemon juice or simmer with lemon zest. Bottle and sterilise in a preserving pan for 10 minutes at 80 °C.

Sorb-apple jam with sorb-apple brandy (H. Fischer, Germany)

Ingredients: 700 g strained pulp from ripe sorb apples, 300 g gelling sugar, 5 table spoons of sorb-apple brandy.

Stirring constantly, boil sugar with sorb apples for 3–4 minutes, then stir in brandy. Fill into warmed jars. Perfect with ice cream, waffles, and pancakes.

Sorb-apple jam with plums (H. Fischer, Germany)

Ingredients: 700 g strained pulp from ripe sorb apples, 200 g stoned plums, 500 g gelling sugar.

Grind or mix sorb apples and boil them for 3–4 minutes with gelling sugar while stirring continuously. Fill into warmed jars. Perfect with ice cream, waffles, and pancakes.

Seasoned sorb-apple jam (H. Fischer, Germany)

Ingredients: 700 g strained pulp from ripe sorb apples, 2 dl red wine, 300 g gelling sugar, a bit of cinnamon, aniseed, cardamom, or other favourite spices.

Mix all ingredients and boil for 3–4 minutes while stirring continuously; fill into warmed jars. Pour a bit of sorb apple brandy on top of the jam. Perfect with ice cream, waffles, and pancakes.

Sorb-apple wine and liqueur

It is likely that sorb-apple wine was one of the first alcoholic drinks in many countries. It was as early as Virgil (70–19 BC) and Palladius (4th century AD) who documented the presence of sorb-apple wine production in Ancient Rome. In the Middle Ages, fruit wine was produced from a mixture of quinces, medlars, cornels, and wild pears. It was called *curmi* in the 5th century in France, and this name survived in the Irish word *cuirm*, which means "beer" (Lieutaghi, 1975). Sorb-apple *curmi* was infamous for causing intoxication and having an adverse effect on the intellectual functions in the long run (Moinet, 2009). Sorb apples imported from France have rarely been used up to now in southern England to produce fruit beer (Russell et Cutler, 2007).

Intoxication from sorb apples

Sorb apples, sometimes referred to as *poirasses* in France, were formerly eaten overripe, which is the time when they started to ferment and contain alcohol. According to our sources, sorb apples occasionally appeared along roads; people could stop by service trees on their way to school, field, or market. Farm animals were also frequent consumers of sorb apples. The story goes that when sorb apples covered the ground, pigs rushed to the tree to eat them; in case the fruit had been fermented, the animals got drunk. When a goat was tied to the tree, it staggered when it walked

Sorb-apple crop in Sarthe (4, 2009).

in the evening. Wild animals did not lag behind: boars, starlings, and blackbirds were all in raptures. There were so many jokes about sorb apples! A young woman attended sorb-apple harvest in Sarthe. She ate much of the fruit so at the end of the day she could not stand still. She was drunk and had to go to bed. An eighty-year-old man recounts that when he was a child and had to watch over cows, he sat down under a service tree. He thought: "Sorb apples are ripe, I'll just eat the ones on the ground, then I'm going to shake the branches and eat the ones that fall off." Late in the afternoon, cows returned to the stable on their own. "My parents came to pick me up in their truck in the evening. I was drunk, having a siesta!" (Moinet, 2009).

In the 18th century, sorb-apple cider was regularly added to apple cider in France, Switzerland and Germany. Sorb apples contain a large amount of organic acids and tannin before they are fully ripe, which is why they were supplied as a natural preservative into grape, apple, and pear cider. Exclusively ripe but not overripe fruit has to be used (Moinet, 2009). By adding sorb-apple juice, fruit cider was naturally cleaned so it stayed limpid and its overall taste and durability improved (Paganová, 2008; Moinet, 2009). In the vicinity of Frankfurt am Main, Germany, cider made of apples and sorb apples has been produced up until today. The percentage of sorb-apple cider (from unripe fruit) in comparison to apple cider is only 2–3 % (Kausch, 2000) or just 1 % (personal utterance, H. Fischer, 2012). In 1852, Couverchel presented a method that seemed innovative in his period – to mix apple wine with ground sorb

apples: "... in order to refine the wine and remove scum according to the method from Germany; then we leave the mixture for 15 days and start to bottle without further cleaning." (Moinet, 2009). In Spain, sorb-apple cider was added into apple and grape cider for the production of wine with a better colour and durability. Grape wine and in higher altitudes also apple wine with added sorb apples was locally produced at the border of Moravia and Slovakia until the half of the 20th century. In the 18th and 19th centuries, 1/3 of sorb-apple cider and 2/3 of apple cider were probably used. Sorb apples have locally been added at least into home-made wine and brandy to improve the taste and quality of the drinks (Hrdoušek et al., 2003). In Slovakia, the recommended ratio for diluting fruit wine with sorb apples is 10 : 1 or 10 : 2. Such wine supposedly places less burden on the stomach and intestines, and has better taste and durability even without using chemical preservatives.

Sorb-apple wine and jam from Germany (3, 2000).

Apple cider with sorb apples from Kronberg, Germany (1, 2012).

Cormé – the first fruit wine

It was as early as the Middle Ages since bactericidal effect has been ascribed to fermented drinks – they represented an alternative and certain protection when drinking water of dubious quality, such as water from rivers, ponds, or wells. According to Charles Etienne (1577), the first fruit wine in the region of Europe was made of sorb apples because the service tree was the only fruit tree that produced edible fruit in large amounts that could be dried for storage. In documents and historical resources, *cormé* predominantly denotes a fermented beverage made of sorb apples – unfortunately there is no description of the preparation procedures. As we already pointed out before, *cormier* (service tree) comes from the Celtic word *curmi*, which generally denoted a fermented beverage as well as cereal beer (Moinet, 2009).

A producer of sorb-apple products from France (4, 2009).

Two main procedures are determinant for the production of *cormé*: either pressing of sorb apples (similar to today's production of apple cider) or maceration = soaking fruit in water. The production process differed from region to region. Pressing

required more sorb apples but produced better-quality fruit juice. However, a press was needed for its production. The press as a technical innovation appeared in 13th century France, which means that pressing was used later than maceration. Sorb apples were used not only individually but also in combination with other fruit – pears, apples, or grapes (Moinet, 2009). *Cormé* or *boisson de cormes* is a beverage originally from France and Switzerland, and it is made of pounded ripe sorb apples. Pounded sorb apples

A small bistro called At the Service Tree is located on the Žerotín hill near Strážnice, Moravia (2, 2012).

are mixed with water and then fermented in oak barrels. In modern age, even sugar has started to be added into the beverage for better fermentation. Fermented filtered juice was then served as young wine or cider. In the past, *cormé* was considered a drink for the poor who could not afford wine. Drinking *cormé* was documented in the 15th century in Mayenne, France; however, lower quality was ascribed to it in comparison with grape wine already in that period. In 1840, J. R. Pesche wrote that in the La Suze canton, all pear varieties were used for the production of cider into which sorb apples were added as well. Contemporaries remember the beverage as late as in the 2nd half of the 20th century when it was regarded a rather seasonal drink (Moinet, 2009). Sorb apples are used for the production of fine *sorbete* or *Sperbelschnaps* liqueur in German-speaking countries (Kausch, 2000).

Sorb-apple wine made by pressing

In his *Discourse on Fruit Wines* from 1577, Charles Etienne often describes the service tree as a fruit woody plant, and dedicates a whole paragraph to sorb-apple wine that served as a model for the production of other fruit wines. This is the procedure: "Pay attention to the fact that sorb apples are half-ripe, before they start falling off the tree. Do not let them ripen completely because they are not worth making wine from when they are ripe. Pound them in a tank, let them ferment, place into the larder or cellar, and keep them as a reserve for as long as possible because the more the beverage is left to age, the better it gets. You will experience its deliciousness when the white liquid loses its bitterness and its taste starts to resemble the taste of wine. Should you want to reduce its bitterness, you can add honey before fermentation." (Moinet, 2009).

Home-made sorb-apple wine from Poitou

Mr. Flamant lived with his parents in Poitou near Poitiers from 1953 to 1955. He recounts: "Drinking wine was a privilege that only the rich enjoyed in this French region. When I was about ten, I used to pick sorb apples with my parents. It was vital to let the fruit ripen, and then we children had to wash it before pouring it into a barrel. We put 3–5 kg of sugar per 50 l of fruit, and we added well water into the barrel. Then we closed it with a cork and sorb apples were left to ferment. *Cormé* was ready after two or three weeks. As children, we drank *cormé* diluted with water. The remains of fruit were thrown away on the manure pile. Later when we had more money, we mixed *cormé* with wine." (Moinet, 2009)

Sorb-apple wine made by maceration

The second method of soaking in a liquid (maceration) is cited in the *Treatise on Fruit Trees* (1756) by Duhamel du Monceau: "... quite a tasty drink can be obtained from juice made of sorb apples that we soak in water." Such drink is called *rapé* according to abbot Rozier. In 1804, Louis Dubois described the process of maceration in great detail: "In order to make *cormé*, we use sorb apples that have not become soft yet. They need to be only yellow with red cheeks (not brown), they must have dark brown seeds and a very sweet taste. We place them in a barrel filled with water – third-filled or half-filled, depending on how much we want the fermented drink to be strong. We leave it open until the fruit becomes fully fermented. Then we seal the barrel well; the drink is ready after eight or ten days. It is a type of quite delicious sour cider, very heady, and its consumption is not harmful." Couverchel added in 1852: "Like grapevines and apples, each extraction is replaced by the same amount of water." This beverage was common in Brittany and Provence according to the author, and was mostly regarded as a drink for festive occasions, probably because of its scarcity and unusual taste. Its taste resembled something between apple must and white wine. Farms producing the drink had certain prestige. *Cormé* was also served as an aperitif on special occasions (Moinet, 2009).

Sorb-apple dishes

In several specialised restaurants in Germany (south of Würzburg), ripe sorb apples are preserved with seasonings and sold as local specialities. Sorb-apple jelly, compote, and compote with white wine are made in Switzerland (Stoner, 2000). In Morocco, dried sorb apples are boiled and served with cous-cous as an accompaniment to mutton (Špišek, 2009). In the Slovak region of Spiš, well-seasoned sorb apples were served as an accompaniment to meat. Sorb apples are preserved in a sweet-and-sour pickle liquid and served with common dishes in Bulgaria (Sus, 1999). In Ukraine, sorb apples are added into sweets and pastries, and are also used for the production of good-quality vinegar. Short story *The Idyll of Šťávnice* by Czech writer Jaroslav Hašek (1883–1923) provides evidence for the fact that sorb apples can be used as stuffing too:
"... So they arrived from Krupina to Almáš where they raise nice and white geese. These are baked together with sorb apples in Šťávnice..." (Hašek, 1920). Other dishes made from sorb apples are described below in Recipes.

Sorb-apple spread

The preparation of sorb-apple spread is described by *Apicius*, a cookbook from the 4th century, later known as *De re coquinaria*, in Book IV, paragraph II: "A dish from sorb apples served either hot or cold: Wash 1 kg of sorb apples, pound them in a mortar, and strain. Take four boiled veal brains and remove the membranes. Put 10 g of black pepper into a mortar, pour fish sauce, and pound. Add strained sorb apples, eight raw eggs, four spoons of fish sauce and mix well. Grease a flat pan, pour in the mixture, cover, place into hot ash and cover by hot ash from the top as well. When ready, serve seasoned with black pepper – either hot or cold."

WINE AND LIQUEUR RECIPES

Cormé wine preparation (E. Moinet, France)

First of all, we need overripe service tree fruit (despite instructions in older publications that recommend using ripe, but not overripe fruit). Put a layer of ripe service tree fruit into the press, followed by a layer of hay or linen, then another layer of service tree fruit etc. The fruit doesn't have to be mashed beforehand. Gently press for two to three days – the longer, the better will the resulting wine be. Tighten the screw every two hours. Afterwards, pour the juice into a large barrel and leave to ferment for about a month. The resulting beverage has a similar taste to sweet white wine and contains 15% of alcohol. It tends to sparkle and is therefore filled primarily into champagne bottles with porcelain stoppers. After opening, cormé quickly goes flat, oxidises and goes stale. The taste of this beverage varies depending on the pressed variety. Red and yellow fruit leads to fruitier and sweeter juice than the grey fruit. From 200 kg of service tree fruit, one can produce approximately 100 l of cormé beverage.

Service tree wine (F. Strelka, Slovakia)

Ingredients: ripe service tree fruit, sugar, water. Pulp soft, brown service tree fruit and pour equal amount of water over it. Heat the mixture to boiling and press it after cooling down. Add 1 000–1 200 g of sugar for 5 l of juice. Finally, ferment the sweetened juice with pure yeast culture.

Mixed wines (F. Strelka, Slovakia)

Service tree fruit is invaluable for the improvement of pear and apple wines, clearing them of sediment and extending their shelf-life. Add 1 l of service tree cider for every 10 l of apple cider. For every 10 l of pear cider, add 2 l of service tree cider. Afterwards process like wine.

Service tree fruit liqueur (E.Moinet, France)

Pick overripe and clean fruit. Put the fruit into a big bottle or a carboy and pour mild fruit alcohol over it (grape brandy, cider brandy). Leave to soak for several months. Afterwards, take the fruit out and press it for juice. Make syrup (mix juice and sugar with 3 glasses of water in 1:1 ratio) and leave to cool. Mix syrup with alcohol, filter and fill into bottles. Liqueur should be consumed after being left for a month to age.

Liqueur Cormier (Z. Špišek)

Ingredients: 2 kg service tree fruit, 1 l vodka, 2 dl water, 1 kg sugar, 1 vanilla pod, 10 almonds. Mix service tree fruit juice and vodka, add vanilla and almonds and leave to age for about a month. Dissolve the sugar in water and mix while cold with pre-filtered infusion. Leave to age for 2 months for the tastes to blend. After ageing, serve this delicious beverage with 20-35% alcohol content as an aperitif.

Girly drink (V. Hrdoušek)

Ingredients: 1 l alcohol, ideally mild rye or grape brandy, 2 dl service tree fruit juice. Mix quality brandy with strained juice, leave to age for a month. Drink chilled.

Service tree kiss (H. Fischer, Germany)

Put a ripe fruit between your lips and take a sip of service tree brandy over it. Enjoy the blend of tastes.

Service tree liqueur with honey (V. Hrdoušek)

Ingredients: 1 l service tree brandy, 1 dl honey, 1 dl of service tree brandy with soaked lime blossom. Mix quality service tree brandy with liquid honey and brandy with soaked lime blossom, leave to age. Drink chilled. Good when you've got a cold.

SERVICE TREE FOOD RECIPES

Service tree gingerbread (L. Polášková, M. Hrdoušková)

Ingredients: 300 g plain flour (extra fine if available), 200 g ground sugar, 1 egg, 2 sp milk, 2 sp rum, 1 sp honey, 1/2 baking powder, service tree jam, whole walnuts.

Knead the ingredients into a smooth dough, leave to rise overnight. Divide into 3 parts. Roll each part out onto a sheet as long as the baking tray and 15 cm wide and spread service tree jam along the middle. You may also sprinkle with whole walnuts. Fold the edges inward so they meet in the middle. Put on the baking tray and brush with beaten egg to add shine and smoothness. Bake in an oven preheated to 180 °C until brown. (see fig.)

Service tree gingerbread (1, 2011).

Service tree balls (M. Polášková)

Ingredients: 500 g plain flour, 1 egg, a pinch of salt, service tree jam, dried service tree fruit. Mix the flour, egg and salt, scald with hot water and knead into dough. Knead the dough into a roll, cut into pieces. Manually expand the pieces and fill with service tree jam, afterwards roll into balls. Throw the balls into boiling water and cook for 7 minutes. Butter the balls immediately after cooking. Grind service tree fruit in a walnut grinder, mix with sugar and sprinkle the mixture over buttered balls according to preference.

Kronberg service tree dream – a dessert (H. Fischer, Germany)

Ingredients: 500 g cored ripe service tree fruit, 200 g sponge cake for kids, 6-8 large sp of service tree brandy, 250 g cream cheese (Philadelphia or similar), 200 g fat quark, 75 g sugar, 1 vanilla sugar package, 100 g whipping cream, a pinch of cinnamon (for decoration). Mix quark, cream cheese, sugar and whipping cream into a smooth mixture. Line the baking tin with aluminium foil. Put a layer of sponge cake (can be shredded) in the baking tin and drip service tree brandy over it.

Then cover with a layer of pulped service tree fruit and spread the quark cream over it. Put into the fridge for 5-8 hrs. Serve sprinkled with cinnamon. Cinnamon can be sprinkled over a decorative service tree leaf template (see fig.).

Service tree dream (1, 2011).

Large-fruited service tree suitable for kitchen processing (1, 2009).

Service tree rum pot (H. Fischer, Germany) Pulp cored ripe fruit and put it in a pot with an appropriate amount of rum, add star anise, whole cinnamon stick, raisins, gingerbread spice and an appropriate amount of sugar. Leave to age for three months. Eat with friends.

Charlotte, service tree dessert (E. Moinet, France) Prepare a mixture from 500 g service tree fruit pulp, 1 cup of sour cream, 1 cup of white fromage blanc cheese, 100 g sugar and the juice from 1/2 of a citron. Line the baking tin with biscuits lightly soaked in a sugar solution flavoured with a drop of calvados (apple brandy) or cormé liqueur. Alternate service tree fruit layers (sufficiently thick) with biscuit layers. The top layer should be biscuits. Leave the desert overnight, serve chilled.

Service tree jelly (H. Fischer, Germany)
Ingredients: 800 g ripe cored service tree fruit, 100 ml apple wine, 500 g sugar, 2 packages of kitchen gelatine.
Boil service tree fruit with sugar; mix with gelatine prepared according to instructions and with apple wine. Spread the resulting mixture in a thin layer on baking paper (or aluminium foil) and leave to dry for several days (occasionally turn over). Cut into cubes and leave to dry for several more days. May be sprinkled with powdered (castor) sugar. Keep in a tight jar like candy (see fig.).

Service tree jelly from Kronberg, Germany (1, 2012).

Flambéed service tree fruit (Z. Špišek)
Ingredients: 300 g ripe service tree fruit, 300 g fresh pineapple fruit, 150 g butter, 120 g brown unrefined cane sugar, 1 lime, 50 ml service tree brandy.
Melt the butter in a frying pan and add sugar. Leave the sugar to caramelize on a mild flame. Put halved and cleaned service tree fruit in the pan together with pineapple pieces and thoroughly stir the mixture. Pour brandy in the heated fruit and light it on fire. Drizzle with lime juice before serving.

Service tree cake (H. Špišková)

Ingredients: 3 eggs, ½ cup semolina, ½ cup oil, 1 ½ cup plain flour, 2 cups halved and cored ripe service tree fruit, ½ cup walnuts, 1 tsp cinnamon, 1 baking powder. Beat egg with sugar and gradually add the other ingredients. Grease the baking tray and line with baking paper or use flour. Prepare dough and pour it into the baking tray. Put the halved fruit on top. Bake in oven at 200 °C for approximately 30 minutes.

Rolls with ground service tree fruit (B. Krška)

Ingredients: dried service tree fruit, 400-500 g plain flour (extra fine if available), sugar, salt, yeast, 1 egg, oil or melted cooking fat, 3 boiled potatoes, semolina for kids.

Prepare the starter dough out of a bit of flour, sugar, yeast and warm water (or milk). Shred cold boiled potatoes in the flour, add 1 egg, a bit of oil (cooking fat) and finally add the starter dough. Mix, add a pinch of salt and prepare the dough. Divide into pieces, roll out, brush with oil or cooking fat and sprinkle with semolina. Roll into shape, put on a greased baking tin, brush with oil (cooking fat) and leave to rise. Bake in oven at a higher temperature (200 °C). Cut rolls into halves after they cool down. Put them down baked side down and sprinkle with ground dried service tree fruit with sugar. This ground mixture is also suitable for other pastries or even pasta (like noodles).

Pork roast sauce (E. Moinet, France)

Pour water from boiling service tree fruit into a baking tray or frying pan after roasting meat, add 2-3 sp service tree pulp, a bit of cream, salt and pepper. This sauce is a delicacy.

Service tree fruit bread (E. Moinet, France)

Ingredients: 300 g flour, 25 g yeast, 10 g salt, 300 g pulp from slightly dried service tree fruit, 1 dl lukewarm water, 1 dl juice from boiled service tree fruit.

1. Day: Pour lukewarm water into a big bowl; add crumbled yeast and 100 g of flour. Knead into soft and supple dough. Cover with dishcloth and leave to rise overnight.
2. day: Add the rest of the flour and the service tree fruit into the bowl, mix and add salt (2 tsp). Knead 10-15 minutes. If the dough is too dry, add some boiled service tree fruit juice. Cover with dishcloth and leave to rise in a warm place. The dough should rise to twice its volume. Interrupt the rising and knead for another 5-10 minutes. Put the dough into a thoroughly greased baking tin (dough should reach to ¾ of its height at most). Cover with dishcloth (do not use aluminium foil) and leave to rise in an oven for 30 to 60 minutes. Afterwards, carefully take the dough out of the baking tin and bake it in a pre-heated oven. Bake for ¾ hr in an oven together with a cup of water.

"Frgál" cake with service tree fruit jam (2, 2012).

Service tree fruit brandy

On the Moravian-Slovakian border and in some places in Lower Austria, Bavaria, Hessia and Hungaria, the typical use for the fruit is the preparation of aromatic brandy. This is a rare and valuable fruit distilled liquor with very specific taste and fruity aroma. Compared to other Sorbus family plants, the service tree fruit contains more sugar and more suitable composition of aromatic substances for the preparation of brandy. As early as 1914, Czech Farmer's Encyclopaedia mentions that the service tree fruit is suitable for the preparation of good brandy (Tetera, 2006). The brandy tastes similar to pear brandy from older cultivars, with a hint of rowan and a slight bitter taste on palate. It has a delicious aroma, often with spicy finish. Brandy, called "oskerušovice" in Moravia, is typical and unique. Pure service tree brandy is often attributed medicinal properties. It helps prevent and treat digestion problems, regulates and clears lymphatic and blood system, and helps with low blood pressure. Its medicinal properties are also currently used to prevent several lifestyle diseases. The curative effects of this distilled liquor are also supported by great interest of healthcare professionals in the entire region of Central Europe. This interest started when the fruit was first being processed and lasts until present time. A bottle of this high quality alcoholic spirit costs around 40 EUR per litre. Samples that have won awards at various tasting events ("košty") can reach up to 100 EUR per litre (Kausch, 2000). In the Czech Republic, the price is around 700 to 1000 CZK. On the other hand, the service tree fruit is virtually never used for brandy preparation in the majority of Mediterranean countries, such as Croatia, Italy and Spain (Hrdoušek et. al, 2003).

On the Moravian-Slovakian border, the vast majority of private-owned service tree production is used to make brandy. Selected brands are available to the general public at popularization tasting events ("košty") near Strážnice. The biggest events are held in Tvarožná Lhota village. The most important of these events is so-called "Service Tree Fair" ("Slavnost oskeruší"), held annually in April, where up to 150 samples of service tree brandy is presented (see fig.). Another significant event is "Service Tree Harvest" ("Oskorušobraní"), which is held annually in the second half of September. Aside from the tasting of brandy, there is also tasting and sale of various service tree fruit products, like ciders, jams, syrups, canned fruits, tea and wooden products.

The ceremonial dubbing of the Bearers of Service Tree Tradition at Service Tree Fair in 2004 (1, 2004).

Brandy preparation

The picking of the fruit and the processing of the ferment can be difficult and the distillation yields can vary. The yield is dependent mostly on the quality of ferment processing. Pick the fruit only after they fall naturally. Do not shake off nor pick the fruit from the tree. A premature picking will lead to a small yield, lower quality and worse taste of the brandy. It is not necessary to let the fruit freeze (Hrdoušek et all, 2003). After the picking, the fruit must be left to ripen. This is best achieved by spreading the fruit in a thin layer on a dry, clean surface, such as concrete, bed sheet, wooden planks or vegetable crates, ideally in a sunny place. The fruit has to be checked regularly. Remove the fruit that is already ripe. Ripe fruit can be identified by its darker (brown) peel and softness of the fruit. In overripe fruit, after peeling off the skin, there should be white or slightly brown pulp mass under a brown layer (Kovanda, 2003). According to the experiences of Moravian-Slovakian border region farmers (Hrdoušek et al., 2003); brown soft overripe service tree fruit without any mould infection (white marks, film) signs should be put into the fermenting vat without mashing the fruit. After filling half of the vat, add 1 kg sugar or, better yet, 10 kg of very sweet fruit(pears, plums) to start the fermentation and add 10 l lukewarm potable water. Add service tree fruit as it ripens. After the vat is 3/4 full, mash the contents with a mash paddle and again add 10 l of water. Only leave 10 cm from the top edge of the vat free. Carefully cover the vat with a cover and occasionally stir. The fermentation is sufficient if the vat is left to ferment for approximately 6 weeks at 15 to 20 °C and the sugar content drops below 4 degrees. Afterwards, distillate the ferment. The distillation must be slow and without temperature fluctuations. According to Mrs. Vítková (born 1922) from Tvarožná Lhota, apples or apple juice should be added to ferment. This allegedly prevents burning (Hrdoušek et al., 2003).

In 2004, the yield from the tree owned by Mr. Sasín from Strážnice was 1 200 kg of fruit (F. Sasín, 2004).

Tasting of service tree brandy at the 1st annual Service Tree Fair in Tvarožná Lhota (1, 2002).

Ripe fruit suitable for brandy preparation (2, 2006).

Around 10 l of 50 % distilled liquor can be gained from 100 l of ferment prepared from ripe and properly processed fruit. Improperly processed ferment (unripe fruit, dry ferment, unsuitable fermentation temperature) can yield only 1-3 l of liquor, or even none at all (Hrdoušek et al., 2003).

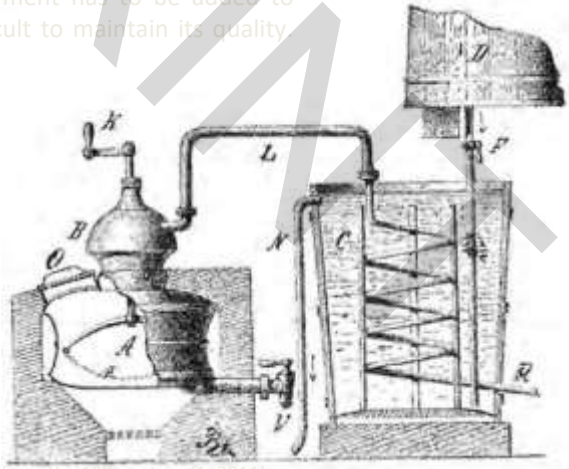
Motto: "Good and tasty brandy can only be distilled from good ferment."

Detailed process of clean "oskorušovica" (service tree brandy) preparation
according to Petr Mach, Březnice, 12. 8. 2006

"Oskorušovica is the best doctor" (M. Hrdoušková, 2003).

Ferment preparation

Put suitably ripe fruit with stems and other impurities (leaves, branches, rotten fruit) into a clean, well-rinsed barrel. It is advisable to also limit the amount of fruit infected with other diseases, such as scab disease, since this can lead to the brandy being too bitter. Place the barrel in a location with a constant temperature (meaning indoors, since autumn temperatures can fluctuate widely). The ideal temperature range is 15-20 °C; therefore it is best to place the barrel in a clean cellar or dark shed. Fermentation at higher temperatures is unsuitable; the sludge will ferment very quickly and will have difficulties reaching similar degrees of fermentation after you add more fruit. Due to the uneven ripening of the fruit, the ferment has to be added to gradually – therefore it is more difficult to maintain its quality. Pulp the fruit before putting it into the barrel, ideally by hand. This allows for a more even and overall better fermentation. It is not advised to grind or completely mash the fruit, since this can exacerbate the "seed taste" of the end product. As the widespread opinion goes, „The service tree fruit won't ferment without added sugar..." However, this opinion is false and is supported mainly by the owners of distilleries, who mostly aim at



A drawing of a distillation apparatus from the 19th century (1, 2011).

quantity, not quality. It is not recommended to add beet sugar into the ferment, even if this leads to a higher yield in alcohol volume, because it lowers the quality of the liquor taste, which is otherwise highly valued. Even though it's often said that beet sugar is necessary to start the fermentation, this is not true. If the fermentation doesn't start, this could be due to acidity, tannins or temperature. This could be solved by adding the starting ferment from other, well-fermenting mixture (plum or pear), or filtered ferment from wine or other yeasts prepared ahead of the time. When adding more fruit into the ferment, always add enough clean water for all the fruit to be submerged so there is no oxidation due to fruit being in contact with air. It is important to add water, because the service tree fruit doesn't have as much juice in its pulp as other fruit, such as plum. When preparing the ferment, it is recommended to stir the mixture so that the fermentation process is even. This can be done when adding new fruit and water, until the barrel is full or otherwise at least twice a week. Keep the barrel covered with a loose lid.

Fermentation and ferment care

The fermentation and ferment care is a very important part of brandy preparation, which is often unjustly underestimated. The barrel with the ferment has to be filled as much as possible while still ensuring it doesn't run over during the fermentation (approximately 15–20 cm from the upper edge), but also ensuring there isn't too much of an air gap between the mixture surface and the lid. This reduces the risk of undesired processes during the fermentation – rotting, vinegar production, moulding – and hence the risk of ferment spoilage. The fermentation barrel should be loosely covered with a lid, so that the produced carbon dioxide can escape. This microclimate protects and keeps the surface of the ferment clean.

Stir the ferment during fermentation, usually once to thrice a week – this often leads to dispute about stirring. However, stirring ensures that the fermentation is even, there isn't any moulding or oxidation, and the "cake" on the surface doesn't form at all or forms only by the end of the fermentation process, when you should stop stirring, since the produced alcohol content protects the ferment mixture rotten) does form, it has to be removed before from spoiling. If the "cake" (dried layer on the surface of the ferment composed of fruit that is often mouldy

Traditional two vessel distilleries with the purification process in Strážnice and Vnorovy (1, 2011).

Tending the fire under the raw distillation vessel, where so-called "lajtr", used for the second distillation stage, is produced, Strážnice (1, 2010).

or it sinks into the ferment, so that the mouldy and rotten remains do not pollute the rest of the ferment. The ideal time to remove the cake is usually shortly before or immediately after the end of the fermentation process, when it begins to sink. If the cake is left submerged in the ferment for a longer period of time or is distilled along with the ferment, this (almost) always leads to the lower quality of brandy taste.

Distillation

Ideally, distillation should be performed as soon as possible after the fermentation. The end of the fermentation can be identified by measuring the sugar content with a refractometer. The remaining sugar content of ferment before distillation should be around 1-3%. If you're not measuring sugar content, you can establish the proper time for distillation by moving the ferment to a warmer location (16-20 °C). If the fermentation process doesn't restart in 3-4 days, you can start with the distillation. Be aware of the risk of the secondary vinegar fermentation. The distillation process by itself is exactly the same as with other fruit. The ferment has to be sufficiently diluted with water so that it doesn't burn in the vessel. In the final distillation, catch the first 0.5–1%

of alcohol (depending on the total volume of "lajtr" – low wine), in order to limit the content of higher alcohols and acetates in liquor. When the alcoholic strength of the incoming alcohol drops below 25%, keep catching smaller amounts (½ or ¼ l), check by taste and therefore regulate the amount of drip to mix according to its quality and taste, so that the liquor isn't polluted by high acidic content or unsuitable aroma.

The finished service tree brandy is often more alcoholic, i.e. it has a higher content of tannins, organic acids, essences and other natural compounds, which translates into strong alcohol smell and sharper taste. Therefore, it is sometimes diluted with high quality soft water. This process is called "flavouring with water". Because of this, the final product often has a lower alcohol content than usual in most of the natural liquors in Moravia region. It is sometimes diluted to 50%, but more often to 48% or even as low as 45%. It is recommended to be patient and wait until the brandy "sets", usually in 2-3 months (see below) and only then finish the dilution to the desired alcohol content, so that the alcohol content isn't too low. Due to the characteristic "overripe pear" flavour and taste, service tree brandy is sometimes mistaken for a brandy made from a certain pear variety. If chilled to a very low temperature, the brandy can contain white or light grey scales (crystals). These are essences crystallized by the low temperatures,

which disappear after the temperature increases again. This is natural and doesn't pose any risks. The yield from natural service tree fruit ferment (without added sugar) is lower than is usual in other fruit, richer in natural sugar, usually around 7 to 9 l for every 100 l of ferment (varying according to region, season etc.).

Mixing service tree fruit in ferment with other fruit (e.g. in case of small yield) has proven particularly worthwhile in the following combinations – plum and service tree (1: 1), also plum, sloe, durancie (local plum variety) and service tree (this combination can lead to strong "core" taste). The service tree fruit is sometimes also mixed with older, overripe variants of pear (also with wild pear).

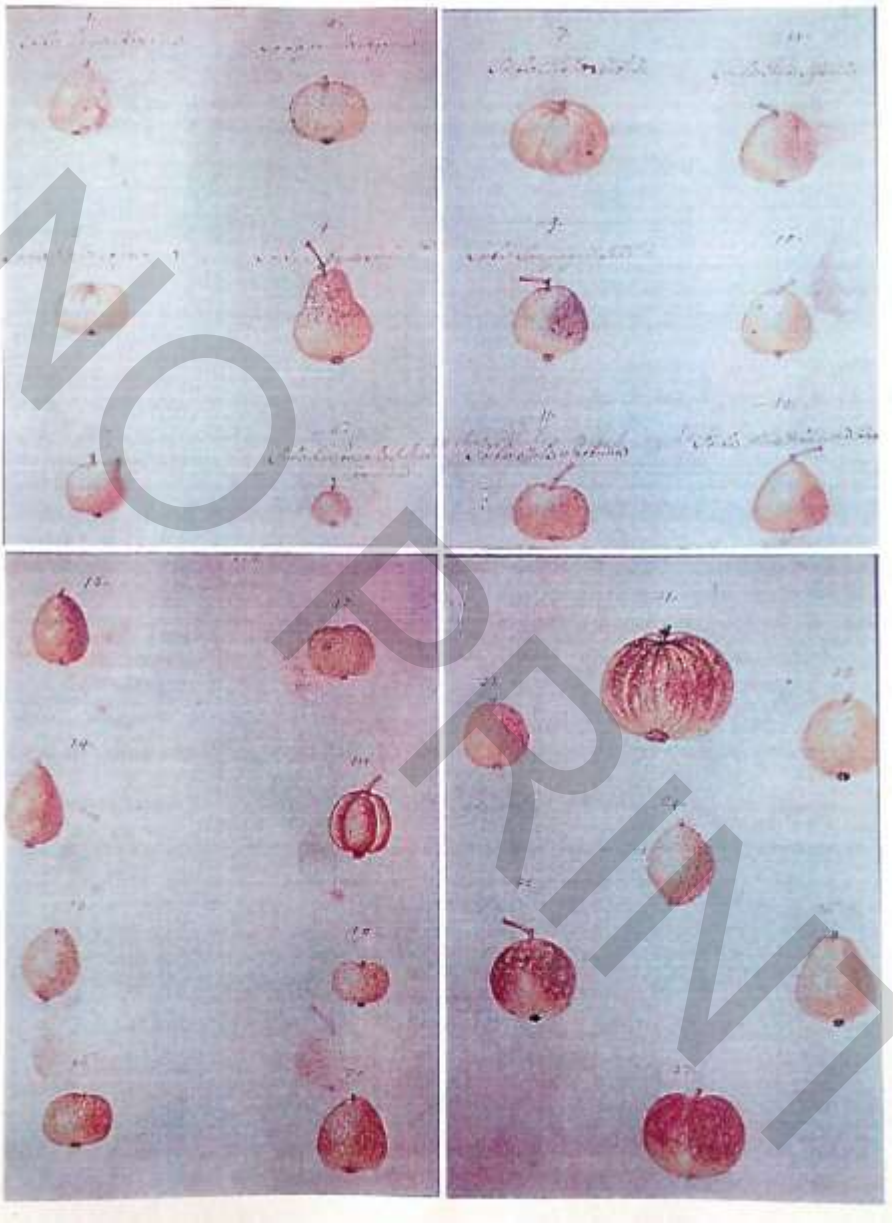
Service tree fruit liquors from Strážnice (1, 2010).

Storage and ageing

Similar to other distilled spirits, "oskoruševica", needs some time to set, when it ages, gains smoother and more distinctive taste and aroma (so called "rounding off"). During this process, certain substances undergo transformation. Best practice is to store the brandy in glass vessels (carboys, bottles) in such a way that for one month after the distillation, the vessel is left open, with the opening covered only by thick clean gauze, separation napkin or cotton wool. This can lead to the decrease of alcohol content up to 0.5%, which should be factored in the final dilution. Afterwards, seal the vessel with clean and dense cork stopper. The liquor can be stored this way. If stored for 5 to 10 years, the smell and taste of good liquor appears and its quality increases.

Service tree brandy preparation in Slovakia, according to Martin Mašušin, Slovakia, 30. 5. 2007

„Service tree ferment is unusually thick, which is why it's usually diluted with water. It is also important to start the distillation at an ideal time. But when you bring service tree into the distillery, everyone will regard you as a VIP farmer and the whole village will come to take a look and give advice. Even the mayor himself came to ogle and leave without doing any work four times. The problem is that the tree sometimes yields so much fruit that you can sit down and gather a full 10 l bucket without standing up, and other times, you can run up and down for the whole autumn and only gather meagre 200 l from three trees. If there really isn't enough fruit to distillate by itself, you can also mix it with wild pear. A friend from Switzerland once brought a 3 dl bottle of liquor, saying I've never tasted something like that before. I tasted it and it was service tree brandy, a very good one at that. So I pulled out one of my bottles and poured a little for him. He was shocked to see that I have such a good liquor, too. And a whole litre, too. It saddened him a little, because it spoiled the pleasant surprise he had for me, bringing the good alcohol from the West to our dreary socialist country. Afterwards, we laughed and proved that alcohol brings people closer regardless of their nationality... As for the price? The 3 dl bottle from Switzerland had cost more than a whole Slovakian litre. When you drink good service tree brandy, remember that if the tradition of its distillation doesn't vanish, the next generations will also have the opportunity to taste these good "tears". The generations before us drank it, we drink it and the generations that come after us will drink it as well. But moderately, my friend, moderately. Too much "tears" can do you harm."



The depiction of different service tree varieties from the 17th century by Italian botanist Micheli of Florence. Micheli pomologically differentiated the service tree varieties by shape, colour and season in the following way: Sorba lunga agostina (1), Sorba tonda agostina (2), Sorba mela agostina (3), Sorba Pera Settembrina (4), Sorba settembrina tonda (5), Sorba lazzeruola salvatica ottobrina (6),Sorba mela settembrina(7),Sorba pera settembrina(8),Sanguignola settembrina (9), Sorba mela ottobrina (11), Sorba pera maggiore (12)... (Bignami, 1999).

XII. Service tree – introduction to pomology

At the moment, there is no truly comprehensive book or study that would deal with the pomology* of the service tree. The following text puts together all the available data and research concerning historical distinctions between service tree types, sorts and local varieties. First, it describes the documented pomological types and varieties found in Europe. The second part focuses on pomological types and varieties of service trees found near the border between Moravia and Slovakia, after further tests and evaluations, the more valuable of these varieties might be used for further plant breeding. The pomological study of the service tree is no different from similar studies of any other fruit – researchers are interested in the quality of the fruit (taste, look, and storage life), early maturing (season or part of year when the variety is productive), and the productivity (size of trees or production areas). Furthermore, it is necessary to study the durability of the trees, how quickly they reach productive age, and how difficult their cultivation is, as well as their resistance to diseases and parasites. The above aspects, as well as the cost of cultivation, are important factors in variety selection. When choosing the right variety, all of these represent important factors.

Depiction of a pear-shaped service tree by Jacob Sturm from the 1796 book "Flowers of Germany in pictures" (http://www.biolib.de).

The oldest service tree pomological evaluations are found in the documents from the Roman era. The *Apicius* cookbook recommends its fruit as a delicacy, a dessert to be consumed after a meal. It argues that the best variety is the one with large red fruits (Kausch, 2000). In his *Naturalis Historia*, Pliny the Elder (23 AD – 79 AD) describes four different types of service tree fruits: round, conical, oval, and a fourth type that he calls *torminalis* – the checker tree (Ajasson, 1833). The medieval literature usually describes only two types of fruits. In his famous and frequently-cited herbarium, Italian doctor Pietro Andrea Mattioli writes this: "The service tree is of two genders, male and female. One can distinguish between them quite easily, because the male tree has apple-shaped round fruits that smell great, while the female tree has pear-shaped fruits that smell worse and that taste quite bitter". The author mistakenly describes the service tree as a dioecious organism, but he is right to distinguish between two varieties – apple-shaped fruits (maliformis) and pear-shaped fruits (pyriformis). This simple pomological distinction is still used today – types of fruits are either apple-shaped (pomifera) or pear-shaped (pyriformis) (Hayne 2002).

***Pomology** – a branch of botany that focuses on distinguishing between fruit varieties and on their categorization and cultivation, as well as on appropriate care for said varieties.

Historically, the fruits were selected and cultivated based on their size and colour, their taste, their maturation period, and their resistance against diseases (Kausch, 2000; Bignami, 2009; Nyári, 2010). Therefore, the biggest fruits occur in places with a long history of service tree cultivation: in Southern and Central Italy, Central France, Central Germany and in Crimea. In some parts of these regions, people still differentiate between individual varieties. We have proof that this was true of more places, specifically of France, Spain, Central Europe, the Balkans, Greece, and Turkey, even though these distinctions survive only in language, sometimes complemented with some scarce historical information. If we take into account

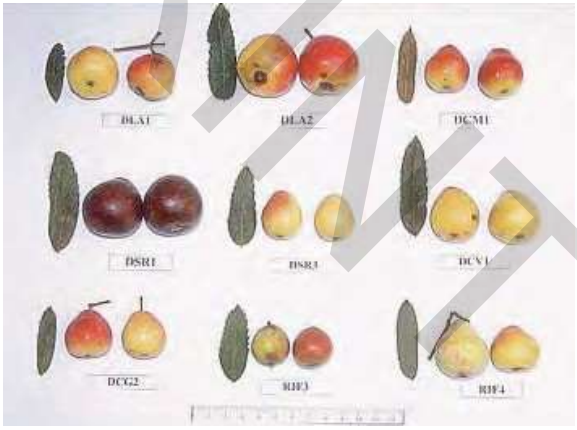
Variability of fruits of selected service tree varieties in the Strážnice region, Southern Moravia (2, 2013).

the whole area of service tree occurrence, we see that, with regards to pomology, the fruits are still very different. In the 1990s, Cristina Bignami documented six groups found in Italy: flat-spherical, spherical, pear-shaped, conical, egg-shaped, and oval (Bignami, 1998). Further studies confirmed that service trees in other countries are also quite varied (see the chapter Variability of the fruits). It is usually safe to assume that all trees with the majority of fruits that are roughly 3 cm large and that weigh more than 10 g are cultivated fruit types (Kárpáti1960; Végvári, 2000; Hrdoušek, 2003; Miletić, 2012; Uherková, 2013).

XII. 1. Pomology of service trees in Europe

Italy

In general, Italians usually distinguish between two types of fruits: maliformis and pyriformis. Historical classification of different varieties is forgotten. Occasionally, some farmers describe and scientists discern the following historical pomological types: "russet sorb" (red-brown service tree), "ashen grey sorb" (grey service tree), "autumnal sorb", "October sorb" etc. (Bignami, 1998).



Variability of fruit types in the Molise region in Central Italy (Bignami, 1998).

However, historical sources tell us that there were many more pomological types (or varieties). Cristina Bignami (1999) discovered that at the beginning of the 18th century, Pier Antonio Micheli (1679 – 1737) documented 34 fruit types of various looks and tastes. He provided both written descriptions and drawings and he distinguished between 4 August, 13 September, and 17 October varieties. These varieties were served at the court of the grand dukes of the House of Medici in Florence. This is evidence of intensive cultivation and breeding efforts; modern

pomological situation, however, does not reflect this. Some of these varieties were documented in 1879 during an investigation led by the Department of Agriculture, Industry, and Commerce.The overview of the service tree types that were known by the beginning of the 20th century was provided by Tamaro (1915), who draws on his own knowledge and cites Pasquale (?) and *Vocabolario d'Agricoltura* (Canevazzi et Marconi, 1892).

An overview of service tree varieties written in the 17th century by a botanist called Micheli, as compiled by Cristina Bignami (1999).

Shape/maturity	August	September	October
flat-spherical	Sorba tonda agostina (2) Sorba mela agostina (3)	Mezzane, tonde e chiatte (2) Sorba mela settembrina (7)	Sorba mela ottobrina (10) (11) Sorba mela ottobrina (23) Sorba mela
spherical	Grosse tonde agostine (1)	Mela grossa settembrina (3) Sorba tonda mezena (4) Settembrina tonda (5) Sorba lazzeruola ottobrina affumicata (25)	Sorba lazzeruola selvatica ottobrina (7) (6) Sorba mela ottobrina (13) Sorba rossa tonda ottobrina (14) Sorba lazzeruola ottobrina (17) Sorbe tonde bianche ottob- rine (19) Sorba mela ottobrina meze- na (20)
conical	Sorba lunga agostina (1)	Lunge, mezzana (4) Sanguinola settembrina (8) (9) Sorba pera maggiore (12) Sorba pera settembrina	Sorba pera mezana ottobrina (9) (12) Sorba pera ottobrina (21) Sorba pera ottobrina (22) Sorba pera culinnazi ottob- rina (22)
egg-shaped			Sorba pera minore rossa (16) Sorba selvatica ottobrina (18) Sorba a gocciola ottobrina (24)
pear-shaped		Sorba zucchetta (6) Sorba pera settembrina (4)	Sorbe pere ottobrine rifte (15)

An overview of service tree varieties known by the beginning of the 20th century, by Tamaro (1915).

Service trees with apple-shaped fruits	Service trees with pear-shaped fruits
Sorba lazzaruola selvatica ottobrina (Canevazzi et Marconi, 1892) – wild, small-fruit variety, with a look similar to *Crataegus azarolus*, maturing in October	**Sorba pera settembrina maggiore** (Canevazzi et Marconi, 1892) – September variety, larger fruits
Sorba mela ottobrina maggiore (Canevazzi et Marconi, 1892) – October variety with larger fruits	**Sorba lunga mezzana** (Canevazzi et Marconi, 1892) – long midle-sized fruits
Sorba mela ottobrina (Canevazzi et Marconi, 1892) – October variety with midle-sized fruits	**Sorba pera ottobrina regata** (Canevazzi et Marconi, 1892) – October variety with small multi-ribbed fruits with dark, russeting skin; fruits mature in storage rooms during the winter
Sorba capitano di Somma (Pasquale) – flat-spherical fruits that mature in December or in January	**Sorba pera tortora** (Canevazzi et Marconi, 1892) – has small fruits with dark, russeting skin; fruits mature in storage rooms during the winter (February, March)
Sorba Panelle (Pasquale) – from the Somma mountain, fruits mature in August	
Sorba agostino (Pasquale) – grows in Naples, also called Sorbo agostegno; small, almost round fruits, red on one side, mature in August	
Sorba autumnale (Pasquale) – autumn variety; flat-spherical fruits, yellow on one side, red on the other; three times as large as Sorba agostino, fruits mature in September	
Sorba tardiva – late-maturing variety, fruits are egg-shaped and mature during the winter	
Sorba varecchiare – found near Somma, matures in December, January, or February	

Fruit types compared to a natural type (small fruit) of sorb apples from around Trieste, Italy (1, 2014).

Historical descriptions of individual varieties were compared with fruits found during field studies carried out mainly in Southern Italy (Bignami, 1999), and it seems that some varieties have survived in the local culture to this day. We are talking about 5 varieties at least: Capitane, Pannelle, Indigniente, Parrocchiane and Nataline (which is sometimes used as a synonym for Parrocchiane). These varieties are still being grafted and cultivated, especially in the Campania region (around Mount Vesuvius) and in Sicily (Bignami et al., 2001; Bignami et Bertazza, 2005). The harvest period of cultivated service tree

varieties in Italy usually comes after that of wild service trees. In the Campania region and in Sicily, the harvest takes places from September till November, when the Parrocchiane variety matures (Bignami, 2000). A short description of varieties that are still cultivated in Campania, Italy (Bignami, 2000):

- Capitane: fruits are 3.3 x 3.8 cm large, weigh between 20 and 33 g, they are conical or flat-conical (depending on location and season), their green-yellow skin is wax-like, with red cheek on 40 to 70 % of the surface, low number of lenticels, harvested in October.
- Indigniente: fruits are 3.3 x 3.6 cm large, weigh between 22 and 27 g, they are conical, their yellow skin is softly wax-like, with red cheek on 50 % of the surface, high number of large russet lenticels, harvested by the end of September.
- Pannelle: fruits are very large, 3.7 x 4 cm, and they weigh between 30 and 40 g, they are oval and egg-shaped, their skin is yellow, with red cheek on 30 % of the surface, low or moderate number of lenticels, harvested by the beginning of September.
- Nataline: fruits are middle-sized or large, 3 x 3.2 cm, they weigh between 17 and 20 g, they are flat-conical, their yellow skin is softly wax-like, with red cheek on 50 % of the surface, moderate number of large russet lenticels, harvested in September.
- Parrocchiane: fruits are large, they weigh between 20 and 25 g, they are pear-shaped, their light yellow skin is wax-like, with small orange cheek, moderate number of lenticels, harvested in November.

Fruits (top to bottom): Capitane, Indigniente, Pannelle, Nataline, Parrocchiane (Bignami, 2000).

Fruits of the Indigniente variety (1, 2007).

Fruits of the Pannelle variety (www.agraria.com).

Between the years 2007 and 2016 we have carried out comparative research of service trees in the regions of Naples and Sicilly. Tens of trees were discovered, with interesting large-fruit types of apples, part of which can be classified as the varieties described above. However, the locals usually do not know them under their variety names and some of them call them by the time of ripening, which corresponds with what Tamaro (1915) states. For the most part, these fruit varieties were grafted – always on a service-tree rootstock. The service trees usually grow solitarily or in small groups of 2–3 trees on the outskirts of orange, almond, olive and other orchards. Seedlings with small, 15–20g, fruits grow in baulks and shrubs. Fruit types, named by the locals as Indignente, Parrocchiane and Panele were found in several varieties that differed in size, time of ripening and taste. Below is the list of the fruit types found.

Indignente: prevailing variety matching the description of Bignami (2000); grows on the hillside of Vesuvius near Naples; it was detected on more than 30 trees, it has a continuous variability matching a single variety; the weight of fruit ranges from 20 to 35 g and the fruit ripens from the end of September.

Large Parrocchiane : this type was found in the Boscoreale village and have no description by Bignami (2000). They were trees with very large fruit, weighing from 25 to 40 g that ripened in October (see photo).

Parrocchiane: matching the description by Bignami (2000); fruits weigh from 15 to 25 g, ripen in November; two trees were found in the St. Anastasia village.

Panelle: matching the description by Bignami (2000); several trees grow above the village of Ercolano, fruits ripen in October.

Yellow Panele: two trees growing near each other were found above the village of St. Anastasia; fruits weigh from 25 to 35 g and ripen as soon as by the end of September.

Indignente variety from Ercolano, variety Large Parrocchiane from Boscoreale and variety Yellow Panele at the hillside of Vesuvius in the village of St. Anastasia.

The Carmine Maiello family is one of the last around Naples to purchase and trade in service-tree fruit, which they are able to discern by variety.

In Sicilly the trees can be found across the whole region. They are rare, growing at the outskirts of gardens, baulks, even in the middle of fields, where they resemble older cultures. The types that became wild have spherical fruit that usually weighs less than 10 grams. Most of the Sicillan trees were not grafted; only in about 10 trees grafting was found; they were mostly classified as the free fruit types described below:

Yellow Parrocchiane – a type with a distinctive pear shape, not pictured by Bignami (2000); with soft yellow skin and – sometimes red – lenticels or an indistinct red cheek and slight rustiness around the stalk, small, slightly protruding sepal dimple. The fruit are approximately 2.5 x 4 cm large were found mainly in central Sicilly on four, probably grafted trees that were 60–100 years old. The fruit weighs 12–22 g (10 pcs – 155 g), sometimes it grows in groups of 2– 3, max. 10– 12, pieces, they have 4–7 large seeds; they ripen at the end of October and last till Christmas.

Red Sicilan – distinctly spherical type of fruit with soft yellowish skin and 30–90% of red cheek, with small, dispersed lenticels, a small, flat to slightly protruding sepal dimple. Fruits with 2 to 2.5 cm in diameter were found even on a non-grafted trees. Very fruitful trees were found in central and eastern Sicilly; the fruit weighs 10–15 g (10 pcs – 135 g) and grows in large groups of 20 to 30 and ripen at the end of October.

Sicilan Nataline – one, approximately 40-year-old tree found in central-west Italy near the village of Prizzi; probably grafted, with very tasteful conical fruit, with yellow skin partially covered with red cheek and small dispersed lenticels. Fruit of the weight of 15 to 25 g grow in small groups of 2–3, max. 10–15, pieces and matures at the beginning of October.

Mr Cippolo and his tree in the Leonfote village; he estimates the age of the tree to be 80 years. Approximately 60 to 80 years old tree with three trunks of the Sicillan Red type and one of the Parrocchiane type found in the village of Resuttano.

Germany and Austria

At the beginning of the 20th century, fruiterers still distinguished between more than 50 pomological types of service tree fruits, with shape and taste being the distinguishing factors (Kausch, 2000). Since 1993, a German movement to save service trees has been growing stronger; Germans even created several fallback pomological collections, namely in Hessia, Bavaria, and Baden-Württemberg. Kausch (2000) writes about several remarkable varieties (see the illustration).

Yellow-brown fruits with notable lenticels from Wiesbaden, large-fruit service trees from a forest in Knittlingen, interesting pear-shaped fruits from young plantings similar to Italian varieties (3, 2000).

A tree with productive grafts of 5 different service tree varieties; Kronberg in Hessia, Germany (1, 2012).

Mr. Hello Fischer from Hessia has been grafting various fruit varieties of service trees for the last 15 years and he uses the fruits to make several interesting products. Conical fruits from large trees are ideal for purées, while those that are apple-shaped (from a tree grafted on a medlar) are suitable for direct consumption (alternatively, unripened apple-shaped fruits can be used to make a cider). Russet fruits, as well as other varieties, can be used to make a brandy. Mr. Fischer finds use even for service trees that mature in October.

The Bavarian Department of viticulture and horticulture has been cultivating service trees with these interesting fruits for the past 10 years. In Veitshöchheim (near Würzburg), they cultivate the largest fruit varieties listed below. The trees are nursed, grafted, and sold to the general public (Doppler, 2006).

- Sossenheimer Riesen = Sossenheim giant – trees are grafted on low trunks and they are moderately productive; conical large-fruit variety with stalk in a small dimple, with red cheek, with noticeable waxy layer and dispersed lenticels. In Bavaria, the fruits mature in September, they are roughly 4.5 cm large and they weigh up to 40 g. Twenty selected large fruits from the 1989 harvest had the average length of 45.9 mm, average width of 42.2 mm and average weight of 39.8 g (Kausch, 2000).

Variability of fruits from service tree sorts cultivated in the vicinity of Kronberg, Germany (1, 2012).



Fruits of the Sossenheimer Riesen variety, in comparison with average fruits, productive grafted tree (3, 2000).

- Red Spätling (Sovenden Nordlicht) – trees are grafted on low trunks, the harvest comes later and it is less bountiful. During autumn, the trees turn an attractive colour; fruits are apple-shaped or slightly conical, and shiny, they have a bright yellow colour with a red cheek, their stalk dimples are somewhat deeper. These large fruits weigh around 30 g (sometimes even 40 g) and they smell and taste great (they are very sweet).


Fruits of the Red Spätling variety and a young grafted tree (3, 2000).Large-fruit variety from a gene pool orchard in Klosterneuburg in Austria (Kirisits, 2000).

Austria can also boast its own large-fruit varieties; in 1999, a gene pool orchard was created near Klosterneuburg. Originally, it had roughly 40 genotypes; unfortunately it had to be eradicated in 2016. Nevertheless these clones and additional ones collected in Austria have been preserved at the Austrian Research Centre for Forests (BFW) and are part of a conservation seed orchard. The large-fruit variety in the picture has just a number assigned to it (Kirisits et al., 2000).

Propagation and grafting of service tree in Veitshöchheim (1, 2015).

France

In France, purposeful cultivation of service trees ceased some 100 years ago, and so we have only a few fragmented documents that would shed some light on the situation. The fruits were categorised based on their shape, size, colour, and intended use (to be consumed directly or to make a drink called "cormier"). Various authors tried to make a list of service tree varieties, but their nomenclatures differ, because their observations had different scopes. Duhamel du Monceau (1765) has a category of the *sativa* service trees that are suitable for grafting, and he further divides them into the following groups:

- service trees with large red pear-shaped fruits,
- service tree with large red fruits, almost pear-shaped and with pale red cheek,
- service trees with pear-shaped fruits that are red on one side,
- service trees with oval fruits that are red on one side,
- service trees with small reddish pear-shaped fruits that mature later.

Service tree types found in the Sarthe region in France (4, 2009).

In his work, Risso (1826) has included a white-fruit service tree variety (S. D. albida).

Risso (1826) differentiates between the following types: Microcarpa (small-fruit variety), Macrocarpa (large-fruit v.), Elongata (elongated-fruit v.), Albida (white v.), Americana (American v.), Aucuparia ("bird" v.), and Serotina (late-maturing v.). It is probable that in his work, he applies the *Sorbus domestica* name to several species, including to the rowan, for instance. In his *Treatise on horticulture* (1861), Du Breuil argues that varieties with red fruits were considered more valuable. A descriptive fruit catalogue that was accepted by the French Pomological Congress of 1873 lists service tree fruits as a kind of fruit that is suitable for cultivation: "Large elongated fruits with greyish-russet colour that are eaten only when overripe. In terms of taste, they are similar to the medlar fruits. There are two cultivated service tree varieties, one with pink fruits and one with red fruits; both of them are used to make drinks." (Moinet, 2009)

Eugene Glady, the owner of fields around Agen, wrote in 1885 that in Bordeaux, Toulouse, Agen, and many other cities in Southern France, the service tree fruits were sold in markets, sometimes overripe, sometimes not quite mature. He pointed out the best varieties, all with large fruits. Even at the beginning of the 20th century, nurserer Andre Leroy from Angers offered half a dozen varieties in his catalogue (Moinet, 2009). This fruit-tree catalogue, written by Andre Leroy from Angers no. 71 (probably 1903), lists the following service tree varieties:

- middle-sized grey-russet elongated fruits,
- middle-sized pink conical fruits,
- middle-sized red spherical fruits,
- large grey-russet elongated fruits,

Service tree sorts founded in region Le Sarth (1,2015).

- large pink spherical fruits for big businesses,

- large red round fruits,

The fruits with grey-russet colour, frequently mentioned in documents from the 19th century and the beginning of the 20th century, are still cultivated today (in various shapes and forms). They are usually between 2 and 3.5 cm large and their whole surface is russeted, but that does not preclude eating them. These fruits are not prone to scabs.

In the years 2014–2017 new information was obtained from field research carried out in the regions of Le Sarth and Burgundy. Most of the service trees found in the regions were not grafted and there were wild young individuals growing in near-natural biotopes. In the Le Sarth region, over 500 trees were found (Moinet, in speach), most of them growing in baulks or on the outskirts of gardens. The largest grafted service tree ever was found on the outskirts of a garden in the le Sarth village of *Thorigné-sur-Dué*. The diameter of its trunk was 340 cm and 300 cm above grafting – at the height of 1.5 m. Its fruit has a conical shape and weighs 15–28 (max. 35) grams. Service tree with the biggest fruits was found in Paris town park. Young not grafted tree gives fruits 20-30 grams height, some fruits has over 50 grams!

The most robust grafted service tree in Thorigné-sur-Dué in the Le Sarth region (1.2015).

The biggest known friuts from Paris looks like italy Indigniente sort (1,2017).

Fig. The fruit sorts weighing 12–25 g that were found in Burgundy were mostly of conical shape.

Fig. The fruit of the longest tree in the Le Sarth region from near the Courdemanche village are only of mid-size and weigh up to 15 g

Service tree fruits with grey-russet colour have diferent size and shape (1, 2015). The biggest grey-russet colour fruits from Le Roc St.Andre in Normandy are 3,5 cm in diameter (Heinemeyer, 2016)

Ukraine

Ukraine is close to a border of the area of service tree natural occurrence; nevertheless, new varieties are being cultivated here. A recent study found 12 varieties. In the Zakarpattia region, near Uzhhorod, villages have their local cultivars (Mezhenskyj, 2012):

- **Barvinok 1** (named by professor V. Zajac) – fruits are slightly pear-shaped, green-yellow with red cheek, and they weigh 15 g,
- **Barvinok 2** (named by professor V. Zajac) – fruits are spherical, green-yellow with a large number of lenticels, and they weigh up to 25 g,
- **Medvedivska** (named by professor V. Zajac) – fruits are pear-shaped, yellow-green with slight sheen, and they weigh 14 g.

Fruits of the Botanična variety in the Kiev botanical garden (V. Mezhenskyj, 2012).

In other parts of Ukraine, service trees are found only in botanical gardens. In the Kiev botanical gardens, there are roughly 10 service trees, including the **Botanična** variety with fruits that weigh, on average, 17 g (personal statement, V. Mezhenskyj, 2012). There are also a few trees of the Karadazka variety in private gardens in Crimea. From a few grafts obtained near Sochi, and in Eastern Ukraine, near Donetsk, fruiterers cultivated two varieties of service trees – Rum`jane jabločko and Rum`jana gruška – that are resistant to frosts and that mature in September and October. The second generation of these varieties is now present in two cities near Donetsk: in Mariupol (in a local forest research station) and in Artemivsk (north of Donetsk), where they are cultivated by Mezhenskyj himself (V. Mezhenskyj, 2012):

- **Karadazka** (named by professor V. Mezhenskyj) – round yellow fruits with red cheek that weigh roughly 20 g; it grows in private gardens (the Kondratiev family) in Crimea, just a few trees. This variety matures in September.

Fruits of the Rum`jana gruška variety (V. Mezhenskyj, 2012).

- **Rum'jana gruška** (named by professor V. Mezhenskyj) – pear-shaped yellow fruits with red cheek that weigh between 12 and 14 g. In Artemivsk, they mature in October.
- **Rum'jane jablučko** (named by professor V. Mezhenskyj) – egg-shaped or round yellow fruits with red cheek that weigh between 12 and 14 g. In Artemivsk, they mature in October.

The Rum`jane variety fruits (V. Mezhenskyj, 2012).

During the mapping that took place during 1950s and that was organized by K. P. Popov, fruiterers and researchers selected pomological types from Krasnokamianka (near Gurzuf) that were grafted on trees on terraces of the Nikitsky Botanical Garden (personal statement, I. Černobaj, 2013). This collection includes many high-quality service tree varieties; unfortunately, a lot of the trees were destroyed. Other trees from various places in Crimea were described as individual varieties. In these places, service tree varieties are still cultivated, produced and grafted (but only on service tree seedlings, usually two years old). Hybridization between different varieties also takes place. In this case, the genes transferred during manual pollination are similar to those that would be transferred through a natural pollination. Fruits of these local varieties are usually between 15 and 35 mm large and they reach full maturity between the second half of September and the end of October (Černobaj, 2010). They are:

Large-fruit service trees on westward-facing slopes above the Ayu-Dag village in Crimea (Turbanov, 2009).

- **Nikita** (P-№ 15, Černobaj, 2010): small tree, 4.5 m tall, with dense compact spherical crown. Fruits are large and usually apple-shaped (although some might have other shapes), with 2 to 6 seeds. They are light yellow in colour and have small indistinct cheek. Productivity is high.

Large-fruit Limonnaja variety on terraces of the Nikitsky Botanical Garden (Černobaj, 2010).

- **Nikita 520** (P-№ 26, Černobaj, 2010): tall tree with a large crown, very large pear-shaped fruits that have yellow skin and indistinct cheek,

Nikita No. 15 (2, 2013).

fruits are usually found in groups numbering between 8 and 12 fruits. They mature in the first half of October, productivity is consistently high.

- **Sladkaja** (P-№ 51, Černobaj, 2010): middle-sized fruits in groups numbering between 13 and 18, oval or pear-shaped, maturing at the end of September, they are attached to the trees only loosely and as soon as they soften at least a little bit, they are no longer bitter, but rather sweet, with a pleasant taste.

Sladkaja (2, 2013).

- Limonnaja (P-№ 34, Černobaj, 2010): smaller trees with large crowns, pear-shaped yellow fruits without a cheek. Found in groups numbering between 6 and 10 fruits, each with 5 seeds (on average), very productive.

Limonnaja (2, 2013).

- Rubinovaja (P-№ 6, Černobaj, 2010): middle-sized trees, large pear-shaped yellow fruits with distinct pink cheek; found in groups numbering between 3 and 5 fruits, mature in October, above average productivity.

Rubinovaja (2, 2013).

- Taurida (P-№ 33, Černobaj, 2010): tall trees, large pear-shaped yellow-green fruits with red cheek (can be quite distinct on some occasions), found in groups numbering between 8 and 12 fruits; fruits mature at the end of September or at the beginning of October, high productivity.

Some large-fruit varieties on terraces of the Nikitsky Botanical Garden are labeled just by numbers (personal statement, Černobaj, 2009). There was another collection of cultivated varieties, which included, among others, the Malorechenskaja, Obilnaja, and Sochnaja varieties, but we were unable to obtain its documentation (Špišek, 2013).

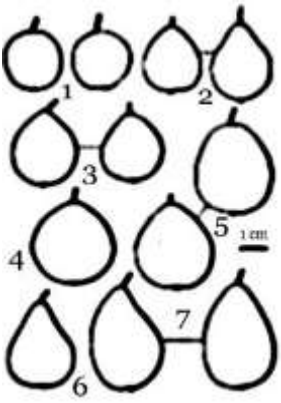
Taurida (2, 2013).

Large-fruit varieties on terraces of the Nikitsky Botanical Garden labeled only by numbers (Černobaj, 2009).

Hungary, Slovakia, and the Czech Republic

In cultivated landscape, service tree fruits found in Hungary are usually more than 15 mm large, which is caused by cultivation choices made along the way (Végvári, 2000); service trees have also been grafted since the Medieval Era, which is probably significant as well (Nyári, 2000). The morphological classification of service tree fruits found in Hungary was written by Pénzés (1956, in Májovský 1992); we include it here in a version modified by Hejný (2003):

1. var. maliformis (Kirchner et Eichler): small spherical fruits, 25 mm large,
2. var. pyriformis (Kirchner et Eichler): fruits 30 x 25 mm large, distinctly pear-shaped, yellow,
3. var. micropyriformis (Pénzés): small fruits, 29 x 23 mm large, spherical or pear-shaped,
4. var. obtusipyriformis (Pénzés): fruits 35 x 30 mm large, chunky or pear-shaped,
5. var. zemplinensis (Pénzés): fruits 40 x 25 mm large, distinctly pear-shaped, yellow with red cheek (see the illustration).



Types of service-tree fruits in Hungary (L. Nyári, 2000).

Miko et Gažo (2004) use this classification for Slovakia, and it is also used in Slovenia (Trnkoczy, 2013). Both the *New flora of the Czech Republic* (Dostál, 1989) and the *Flora of the Czech Republic* (Hejný, 2003) also use varieties classified by Pénzés. During the last study of morphological variability of service tree fruits found in the Czech Republic and Slovakia, researchers discovered that Bignami's shape-based classification (1999) covers the shape variability perfectly (Miko et Gažo, 2002; Špišek, 2009; Uherková, 2013). Pénzés (1959), for instance, does not differentiate between flat-spherical and egg-shaped fruit varieties.

Variability of service tree fruits found in Slovakia (Miko et Gažo, 2002).

Fruits of the largest service trees in Europe:

The largest service trees are still productive – they can be found in Modra in Slovakia (apple-shaped, 2 cm large), in Ockstadt near Kronberg in Germany (pear-shaped, 3 cm large) and on the Žerotín Hill, the Strážnice region, South Moravia, in the Czech Republic (apple-shaped, 2.5 cm large).

XII. 2. Pomological types and varieties of service trees found along the Moravian-Slovakian border

The region along the Moravian-Slovakian border (Southern White Carpathians) boasts both many trees and a high fruit type variability. Based on a field study carried out mainly in the Strážnicko region and on the data from cited literature, researchers identified trees that produce similar fruits. It is possible that these trees share common ancestry and that they sprouted or grew from seeds while retaining many traits of the mother tree. In several cases, researchers found that a tree that was several centuries old produced pomologically similar fruits as other, younger trees in the vicinity that coppiced or grew from seedlings (see the illustration). None of these trees on Moravian-Slovakian border gave any evidence of grafting.

Fruits from four trees of the Subtle pomological type growing in Tvarožná Lhota. The sample in the upper left corner comes from Špiruda's service tree that has 4 m in circumference (1, 2012).

Fruits from four trees of the Loaf-shaped pomological type growing in wineyards in the Strážnice region (1, 2014).

Between 2010 and 2014, researchers identified more pomological types (syn. fruit types) of service trees. Fruits of the same type of service trees are similar. Researchers also noted some transitional types. Fruits found in the region along the Moravian-Slovakian border were compared with types found elsewhere in Europe, as well as with those documented in the literature.

Various local varieties documented in the Strážnice region: Little green from Hroznová Lhota, Reddish from Tasov, and Subtle from the Žerotín hill close to the Moravian-Slovakian border (2, 2012).

In this publication, we include only some of the mid-size- and large-fruit pomological types, and we differentiate between the local varieties that are of interest to further breeding and cultivation. We present multiple examples of each type and one or more trees (and their fruits) of each variety. Local pomological varieties and types were given provisional names derived from their traits (see the table). Regarding the fruits, researchers were interested in the following aspects: time of harvest, average size, shape, colour (base colour and cheek colour), stalk, and stalk dimple (size, shape, structure), skin – surface (wax-like, shiny, russeted…),

lenticels (distribution, colour, shape, quantity), pulp – mesocarp (colour, density, sclereids, taste). Other fruit varieties that are interesting in terms of shape, size, taste, or resistance are listed at the end of the chapter.

Pomological types and documented varieties of interesting trees (from a fruiterer's point of view) along the Moravian-Slovakian border:

Pomological type	Characteristic traits of its fruits	Documented local variety	Weigth (g)*	Specific traits
Chubby	Spherical or slightly conical, large sepal, prominent lenticels	**Chubby**	14.8	Large-fruit type, decorative, can survive transportation.
		Hard Chubby	18.7	Can survive transportation and storage (up to roughly two weeks), very productive, but only during seed years, more susceptible to scabs.
Subtle	Spherical or conical, with a small	**Subtle**	13.2	Good taste, good productivity – productive even during non-seed years.
		Delicate	9.5	Great taste, has to be processed quickly (within 7 days after the harvest).
Reddish	Flat-spherical or spherical,	**Late reddish**	15.5	Late-maturing type, decorative, less prone to scabs, lower productivity.
Barrel-shaped	Flat-spherical or slightly conical	**Early barrel-shaped**	16.5	Early-maturing variety, can survive transportation.
Loaf-shaped	Conical or oval	**Little red**	16.8	Decorative, suitable for all kinds of processing, productive even during non-seed years.
		Little green	18.6	Larg-fruit variety, suitable for all kinds of processing, more prone to scabs, productive even during non-seed years, average taste.
		Little yellow	16.1	Delicate skin, suitable for all kinds of processing.
Bulbous	Bulbous, pear-shaped	***Not documented along the M.-S. border***		Large fruit, late ripening, average taste.

** Weght – average of 10 pieces of fruits at the height of maturity during the 2014 season.*

Pomological type: Chubby

Shapes of this variety according to the Italian typology (Bignami, 1998).

Trees

Trees bearing this fruit type were usually young and of uneven productivity (they are, however, very productive during seed years, which is every two or three years). The oldest documented tree had a trunk circumference of 2.7 m, it was roughly 250 years old, and it grew on the Žerotín hill near Strážnice (1, 2012).

Fruits from three trees of the Chubby variety from the Žerotín hill near Strážnice (1, 2014).

Fruits

Fruits are usually between 2.5 and 4 cm large and they weigh between 9 and 28 g. They are flat-spherical, spherical or conical; in rare cases, they can be slightly egg-shaped. They are yellow or yellow-orange, with red cheek on 30 to 70 % of the surface. There are also sparse but prominent russet lenticels with white borders. Most trees produce fruits without russeting skins; if there is some russeting, it is usually concentrated around the stalk dimple. Skin is rather firm, fruits can survive transportation and storage without rupturing. The sepal dimple is quite prominent; during maturation period, the sepal bed is usually quite distinctive. After the fruits reach full maturity, the sepal is usually very wide and open, with the dry calyx fallen off, and it is either on the surface or in a shallow sepal dimple. The fruits narrow towards the stalk; the stalk is located in a shallow, almost regular stalk dimple with some ribbing. The pulp is ivory-coloured and it has average sweetness, it is juicy, slightly aromatic, and homogenous, with delicate sclerenchyma cells (numerous delicate sclerenchyma cells that do not, however, preclude direct consumption). This type reaches maturity in September. Mature fruits have a delicate smell; they have a dark brown colour and feature prominent lenticels. Fruits are somewhat prone to scabs. This type can be found in two interesting varieties.

The largest tree of the Chubby type in Žerotín and its fruits (1, 2012).

Variety: Chubby

Tree: grows in wineyards along the Dolní Štamfáty line (near Žerotín). The locals call it "Jencek's service tree". The tree is healthy and very productive (but only in seed years), it has large irregular crown. Its trunk has 1.65 m in circumference, the tree is roughly 150 years old.

Fruits: large, spherical or conical, usually between 3 and 3.5 cm large, 10 mature pieces weigh 148g. The largest fruits can weigh over 20 g, with 24 g being the documented maximum. Most fruits are slightly conical, base colour is green or green-yellow, with indistinct red cheek with orange borders that covers up to 50 % of the surface. Most fruits have a "belly" – rather wide, sometimes protruding sepal bed (see the illustration). There are usually sparse, middle-sized russet lenticels on the whole of the surface, the skin has an average firmness, the pulp has an average sweetness with a hint of a spicy taste, somewhat firm, tastes good, sclerenchyma only around the core. Fruits mature between the beginning and the end of September. Large-fruit, decorative variety, can survive transportation, can be used to make various products.

Fruits and tree of the Chubby variety with a large crown (1, 2014).

Variety: Chubby hard

Tree: grows amongst shrubs on the border of wineyards on the Žerotín hill, along the Svislá line. The tree is healthy and it has a large crown with horizontal lower branches. Its productivity is between average and good, but only during seed years. The trunk has 115 cm in circumference, the tree is roughly 80 years old.

Fruits: large, flat-spherical or spherical or slightly conical, some irregular, usually between 3 and 4 cm large; 10 mature pieces weigh 187 g, the largest fruits weigh over 20 g, with 28 g being the documented maximum. The fruits have firm skin and they mature a week after the previous variety; they are roughly 10 % larger. Usually, their skin is not yellow, but green, with a small red cheek (covering up to 30 % of the surface). Lenticels are prominent, but sparse, russet-coloured, with white surroundings. Some fruits have russeting around the stalk. Their stalk bed is rather large, but not protruding. Mature fruits remain firm for a long time and they are brown, with violet undertones. The pulp is homogenous, juicy, slightly sclerenchymatic, aromatic, spicy, and has an average sweetness. Fruits fall down and mature between the second week and the end of September. They can survive storage (up to two weeks) and transportation, the tree is very productive, but only during seed years, and is rather prone to scabs.

Fruit and tree of the Chubby hard variety (1, 2014).

Occurrence along the Moravian-Slovakian border

The pomological type Chubby is described based on findings from several locations along the Moravian-Slovakian border: five trees between 20 and 250 years old on the Žerotín hill (near Strážnice), a few trees in wineyards in Havřice and in Vlčnov, and also in Luhačovice. On the Slovakian side, this type was found only in the Koválovec village.

Fruits harvested at the end of September in Havřice and in Vlčnov, Moravia (1, 2010).

Fruits from a tree of the Chubby variety that grows near Luhačovice (2, 2009).

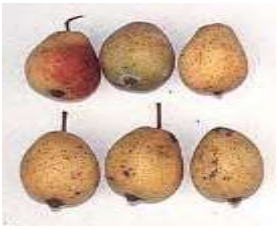
Maturing fruits of the Chubby variety in Koválovec, Slovakia (1, 2011).

Similar types from other regions and from literature

The traits of the Chubby pomological type were found in most of the surveyed regions in Europe. Trees featuring the same or similar traits were found in Pilismarót and in Zalaköveskút in Hungary, in Ercolano in Italy (on the slopes of Mount Vesuvius), and in Kronberg in Germany. This pomological type was probably already described by Micheli, who referred to it as "No. 21" (Bignami, 1999). It would also be reasonable to include the ancient Italian Indigniente variety in this group – it grows in Campania, matures in the second half of September, fruits are roughly 3.5 large and they weigh around 24 g, they feature prominent lenticels over the whole surface and a firm skin. In Hessia, Germany, this type of fruits was used for direct consumption (because of its appealing look and its size) (personal statement, H. Fischer, 2012).

Service tree from Micheli's work from the 17th century (Bignami, 1999).

Service tree on a Slovenian stamp.



The Indigniente variety (Bignami, 1999).

Maturing fruits of the Chubby variety at the end of August in Ercolano, slopes of Mount Vesuvius, Italy (1, 2007).

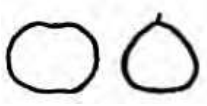
Fruits of the Chubby variety In Kronberg, Germany (1, 2012).

Fruits from a young tree in Cebovce, Slovakia (Bakay, 2012).

Fruits from an orchard near Pilismarót, Hungary (1, 2013).

Fruits of the Chubby variety from the Zalaköveskút village, Hungary (1, 2013)

Pomological type: Subtle



Shapes of this variety according to the Italian typology (Bignami, 1998).

Trees: these trees are average or tall and they are very productive (every two or three years); however, they can often be productive even during non-seed years. This type includes some very old trees growing along the Moravian-Slovakian border (with more than 3 m in circumference), for instance in Tvarožná Lhota or on the Žerotín hill near Strážnice. The oldest documented tree of this type, so-called "Adamec's service tree", is probably more than 450 years old (see the illustration).

Fruits: one of the most common types of service trees growing along the Moravian-Slovakian border. Fruits are between 2 and 3.5 cm large, middle-sized, and they weigh between 7 and 15 g. They are spherical or conical, but length usually isn't greater than width. Mature fruits have rather delicate skin, often shiny, yellow or yellow-orange, with red cheek covering between 20 and 70 % of the surface. Fruits are usually

Fruits of four trees with fruits of the Delicate pomological type from the Žerotín hill near Strážnice (1, 2014).

The fruits feature sparse small russet lenticels; fruits with continuous russeting are rare. The sepal bed is middle-sized or small, usually not protruding, enclosed in shallow regular or slightly circular sepal dimple. The fruits narrow towards the stalk; the stalk is located in a shallow stalk dimple, which can feature slight ribbing. The pulp is yellowish, creamy, delicate, sweet, juicy, aromatic, and homogenous, with just a few sclerenchymatic cells. Fruits mature between the middle and the end of September. Mature fruits usually have a pleasant smell. The fruits are somewhat prone to scabs and are not particularly firm; when pressed, the skin turns dark. When stored, the fruits mature rather quickly – they turn soft in a few days and they need to be used or eaten soon. Mature fruits are light brown in colour. We have selected two interesting trees that might serve as base varieties for further cultivation.

Variety: Subtle

Tree: the tree grows in wineyards below Hotařská búda, below the Žerotín hill near Strážnice. It is healthy and it has a large crown with slightly overhanging branches. Its trunk has 1.65 m in circumference, the tree is roughly 150 years old. Productivity is very high every two or three years, but the tree is productive even during non-seed years.

Fruits: fruits are middle-sized, between 2.5 and 3.5 cm large, weighing between 7 and 15 g, 10 pieces weigh 132 g. Fruits are spherical or conical, the length does not exceed the width. Mature fruits have rather delicate skin, usually shiny, yellow or yellow-orange, with red cheek covering between 20 and 50 % of the surface. Fruits feature sparse small russet lenticels, their skin is smooth, without prominent russeting. Both the stalk and sepal dimples are usually small, the sepal can be visible on the surface and can have a small open sepal bed. Fruits narrow towards the stalk. The short stalk is located in a shallow regular stalk dimple. The pulp is delicate, creamy, sweet, juicy, aromatic, and homogeneous with just a few sclerenchymatic cells. The fruits mature between the middle and the end of September. Mature fruits have a slight pleasant smell. The fruits are somewhat prone to scabs and they are not particularly firm; when pressed, they can crack. When stored, the fruits turn soft in a few days. When mature, they are brown or light brown.

Tree and fruits of the Subtle variety (1, 2013).

Variety: Delicate

Tree: large and with a partially dry crown. The locals call it "Oskoruše na hraně" and it grows in a tree growth near the Žerotín hill near Strážnice, in the Svislá wineyard line. Its trunk has a circumference of 3.3 m and the tree is roughly 300 years old. It is very productive every two or three years.

Fruits: fruits are middle-sized, between 2 and 2.5 cm large, they weigh between 7 and 10 g, 10 pieces weigh 95 g. They are usually yellow, with red cheek covering up to 40 % of the surface, spherical or slightly conical with noticeable waxy layer. The skin is delicate, lenticels are white, sparse and indistinct; the sepal is small and on the surface. The stalk is short and it is located in a small regular dimple. The pulp is delicate, very aromatic, and creamy, with a delicate taste. The fruits have a pleasant smell and they mature during September. They can be used for direct consumption, or to make ciders, licquers etc. The fruits are somewhat prone to scabs and they are not especially firm; when stored in damp environment, they can rupture.

Tree and fruits of the Delicate variety (1, 2013).

Occurrence along the Moravian-Slovakian border

There are many examples of this pomological type Subtle along the Moravian-Slovakian border: many trees have fruits similar to the Subtle variety, not only in Žerotín, in the vicinity of Adamec's service tree, but also in Tvarožná Lhota, where there might be a few descendants of the legendary Špiruda's service tree. Seedlings from the Adamec's service tree that were planted in 1997 in Modrá near Uherské Hradiště also feature traits of this pomological type (see the photo). The largest known service tree that grows in Modra, in the Little Carpathians, in Slovakia, also features this type of fruits. On the other hand, trees with traits similar to the Delicate variety are rare. There are just two such trees in the Žerotín region and one in wineyards near Koválovec in Slovakia (see the illustration).

Fruits from the Adamec's service tree (1, 2014).

Fruits from the Bačík's service tree in Žerotín have traits similar to those of the Subtle variety (1, 2014).

Fruits of a seedling of the Adamec's service tree in Modrá feature a number of traits of the Subtle variety (1, 2014).

Fruits with traits of the Delicate variety with mainly yellow aromatic fruits on the Žerotín hill (2, 2012).

Fruits with traits similar to those of the Delicate variety growing in Koválovec in Slovakia (1, 2012).

Similar types from other regions and from literature

This pomological type was found in most of the surveyed regions in Europe; documented trees of this type are often large and quite old. However, large trees have smaller fruit than young trees. Fruits of this type were found near Zalaköveskút in Hungary, near Michalovice in Bohemia, in Plachtince in Slovakia, in Kronberg in Germany, or in the Sarthe region in France, where they have pink undertones.

It seems that this pomological type (along with the previous one) was first found during a study carried out in the Molise region in Italy (see the illustration). It is probable that the Bovender Nordlicht variety from Veitshöchheim near Wurzburg, Germany, can also be included in this group (see above).

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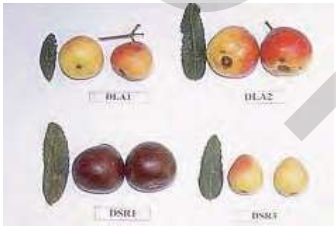
Fruits of the Subtle variety in Koválovec, Slovakia (1, 2011).



Comparison of service tree fruits of the alleged Subtle variety (types DLA1, DSR3) with those of the Chubby variety (types DLA2, DSRI) found in the Molise region (Agnone-Isernia, Italy) (Bignami, 1999).

Fruits from a tree near Michalovice pod Radobylem bear similar traits as those of the Subtle variety (1, 2009).

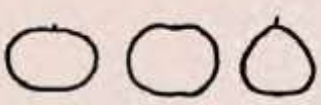
Depiction of service tree fruits, probably of the Subtle variety, drawn in the 18th century, displayed in the Červený Kameň castle near Modra, Slovakia (1, 2010).

Fruits similar to the Delicate variety that can be found near Zalaköveskút, Hungary (1, 2013).

Fruits similar to this variety found in the Sarthe region in France and in Kronberg in Germany (1, 2012).

Pomological type: Barrel-shaped

There are just two documented trees that belong to this variety, both found on the Žerotín hill near Strážnice, and so we describe only the type here.



Shapes of this variety according to the Italian typology (Bignami, 1998

Tree: the tree is large and the locals call it "Bernardi". It has a circumference of 3.2 m and it is roughly 300 years old. There is another young healthy tree nearby, with a circumference of 1.1 m, which is probably its offspring (it bears similar fruits). These trees are located along the Kňahnice line below the Žerotín hill near Strážnice, both have fully-formed crowns and both are part of a tree growth.

A large tree of the Barrel-shaped variety with fruits (1, 2008).

Fruits: the fruits are middle-sized, flat-spherical or spherical (or, in rare cases, conical). On average, they are 3.1 cm wide and 2.9 cm long; 10 mature fruits weigh 251 g. Lenticels are yellow-white, prominent when appearing on mature fruits sometimes on the whole surface, sometimes only around the stalk. Between 10 and 50 % of the surface is usually russeted, most notably around the stalk dimple, which is prone to scabs. The skin is rather firm, the pulp is homogenous, slightly sclerenchymatic, moderately aromatic and sweet. The fruits mature early – between the end of August and the middle of September. They are not prone to scubs and they are resistant to pressure. The early variety can be transported and canned. The fruits of the young trees are more asymmetrical and they have more russeting (more than 50 % of the surface).

Fruits of a young and an old tree of the Barrel-shaped variety (1, 2014).

Maturing fruits of the Barrel-shaped variety still on a tree (1, 2008).

Pomological type: Reddish

Documented trees with fruits of this type were usually young (between 100 and 150 years old), healthy, and with a circumference of up to 150 cm. Researchers found one other tree with similar, but somewhat smaller fruits (weighing between 6 and 10 g) that matured at the

Shapes of this variety according to the Italian typology (Bignami, 1998).

beginning of September (Tetera, 2006; Baňařová, 2007). The fruits are in diametre between 2.5 and 4.5 cm large and they weigh between 8 and 20 g (with the documented maximum of 26 g). They are flat-spherical, spherical or conical, with a hint of a pentagon. Some fruits have irregular shape, others may feature prominent ribbing. The skin is green (turning yellow or orange as the fruit matures), with prominent red cheek covering between 50 and 90 % of the surface. The stalk is short and it is located in a dimple which is ribbed (sometimes very noticeably so). The sepal dimple is shallow and round (and sometimes slightly ribbed), with middle-sized or small slightly protruding bed. The skin is moderately firm and covered in large russet lenticels which often have white borders. Some fruits can feature more prominent russeting, but it is rare. The pulp is moderately firm and somewhat dry, sweet (sometimes even very sweet), aromatic, slightly sclerenchymatic. Fallen fruits do not mature, but rather dry up. This type of service tree produces mature fruits between the end of September and during October. The productivity is average or good, there are usually two harvests every three years.

Fruits of the Reddish type from Tasov, the Czech Republic (2, 2009).

Variety: Late reddish

Tree: is moderately tall and old, with a circumference of 140 cm. It grows on a meadow above wineyards near Hroznová Lhota.

Fruits: fruits are between 2.5 and 4 cm large and they weigh between 8 and 17 g (with the documented maximum of 24 g). 10 pieces weigh 155 g. They are flat-spherical, spherical or conical, with a hint of a pentagon. Some fruits have irregular shape, other may feature prominent ribbing. The skin is green (turning yellow or orange as the fruit matures), with prominent red cheek covering between 50 and 90 % of the surface. The stalk is short and it is located in a dimple which is ribbed (sometimes very noticeably so). The sepal dimple is shallow and round (and sometimes slightly ribbed), with middle-sized or small slightly protruding bed. The skin is moderately firm and covered in large russet lenticels which often have white borders. Some fruits can feature more prominent russeting, but it is rare. The pulp juicy, dense, sweet (sometimes even very sweet), aromatic, slightly sclerenchymatic. This variety produce mature fruits between the end of September and during October (when the leaves begin to fall). The productivity is average or good, there are usually two harvests every three years. Fruits are used for direct consumption or to make products (marmalades, for instance), they can be dried. They are somewhat prone to scabs, but resistant to pressure.

Tree and fruits of the Late reddish variety above wineyards near Hroznová Lhota (3, 2012)

Occurrence along the Moravian-Slovakian border

This type was found on three trees above wineyards near Hroznová Lhota and near Tasov, Moravia, the Czech Republic. Similar fruits were documented on the Žerotín hill and in Pitín (near Luhačovice), the Czech Republic, and in wineyards above Chocholná-Velčice, Slovakia.

Tree and its fruits above wineyards near Hroznová Lhota, the second half of October 2012 (1, 2012).

Tree and its fruits above Tasov, end of September 2012 (2, 2012).

Service tree fruits of the Reddish type from the Žerotín hill near Strážnice, fruits mature at the end of September (1, 2012).

Fruits of the Reddish type harvested at the beginning of October in Pitín, near Luhačovice (2, 2009).

Not-yet-mature fruits, probably of the Reddish type, harvested in Chocholná-Velčice at the end of August (Uherková, 2013).

Similar types from other regions and from literature

Fruits of this decorative pomological type can be also be found elsewhere in the Czech Republic (in České Středohoří, for instance), as well as in Germany or in Hungary.

Not-yet-mature fruits of a young tree of the Reddish type harvested in August in former wineyards near Žalhostice in Bohemia (1, 2008).

Not-yet-mature fruits of the Reddish type harvested in September in the Sonnevend's orchard in the Zala region in Hungary (1, 2012).

Pomological type: Loaf-shaped

Shapes of this variety according to the Italian typology (Bignami, 1998).

Tree: trees bearing this type of fruits are usually found on the borders of wineyards and in gardens, and they are usually quite young (less than 100 years old). The biggest tree found along the Moravian-Slovakian border is the one in Bzenec. The stem is 175 cm in circumference and the tree is roughly 150 years old. It is quite productive even during non-seed years.

Fruits: conical or egg-shaped, with more or less distinct red cheek. These fruits are between 2.5 and 3 x 3 and 4 cm large, they weigh between 9 and 20 g, and they can boast different colours. Usually, they feature no russeting, or just a little bit around the stalk dimple. The stalk is located in a regular round slightly ribbed dimple. The sepal is small, with small calyx on the surface.

Fruits of three trees of the Loaf-shaped type growing in Bzenec and its vicinity (1, 2014).

The whole surface is covered with small lenticels. The skin is delicate. The pulp is juicy, with sparse sclerenchymatic cells, moderately sweet, with slightly spicy taste. The fruits have a pleasant smell and they are somewhat prone to scabs.

Variety: Little yellow (Žlutice)

Tree: the tree has a cifcumference of 120 cm, it is roughly 100 years old and healthy. It grows on a field near Těmice.

Fruits: fruits are egg-shaped, they are between 2.5 and 3 x 3 and 4 cm large, 10 pieces weigh 161 g. However, fruits can also have just a third of this size. The fruits are bright yellow, some may feature red cheek covering between 10 and 20 % of the skin. The whole surface is covered with small lenticels with white borders. The stalk is located in a slightly angled dimple, the sepal is small and on the surface. The skin is delicate. The pulp is whiteish, soft, moderately sweet, with slightly spicy taste. The fruits are not particularly susceptible to scabs.

Tree and fruits of the Little yellow variety from Těmice (1, 2012).

Occurrence along the Moravian-Slovakian border and literature

The Limonnaja variety found in Crimea (see above) can probably be included in this pomological group. Also, service trees with yellow fruits with a similar look were depicted in the Fuchs's herbarium from 1543 (reprophoto Kausch, 2000).

Service tree from the Fuchs's herbarium (3, 2000).

Variety: Little red (Červenka)

Tree: these trees are moderately tall and they have large crowns. One such tree grows in vineyards above Bzenec, its stem has a circumference of 175 cm and it is probably more than 150 years old.

Fruits: the fruits are between 3 and 4 cm long and they weigh between 12 and 22 g, 10 pieces weigh 160 g. Usually, they are conical and they have prominent Fight lenticels with russet centers. As the fruits mature, they turn from green without any cheek to green with red cheek covering between 40 and 80 % of the surface. When fully mature, they are brown or brown-red. The fruits have almost no pretty, the stalk is located in a moderately deep ribbed dimple. The sepal dimple is small, slightly ribbed, with slightly protruding bed. The sepal dimple can have a shape of a pentagon. The pulp is juicy, moderately delicate (sclerenchymatic cells are not a problem), and aromatic. The fruits have a pleasant smell. The fruits mature between the middle of August and the end of September. They are moderately prone to scabs.

There is another, younger tree that grows close to the one we described. It is probably an offspring of the older one. It has smaller fruits with more prominent lenticels, conical, with rib-less dimples. Its fruits mature roughly a week after those of the mother tree.

Fruits from a young tree that are similar to the Reddish type (1, 2012).

Tree and fruits of the Reddish type from Bzenec (4, 2008).

Occurrence along the Moravian-Slovakian border

Trees that bear fruits similar to those of the Red variety can be found on the Žerotín hill near Strážnice and in Nová Bošáca, in the White Carpathians, Slovakia.

Trees similar to the Red variety from a young tree on the Žerotín hill near Strážnice (2, 2012).

Not-yet-mature fruits from a tree in Nová Bošáca (Uherková, 2013).

Similar types from other regions and from literature Fruits similar to those of the Little red variety were found in Hessia, Germany. Some of these trees were particularly large (having more than 4 m in circumference). Also, we can probably include the Sossenheimer Riesen variety in this group as well. Fruits of similar shapes are often depicted in literature.

Large yellow-red service tree fruits that were first called Sorbus domestica *(reprophoto 3, 2000).*

Variety: LittleGreen (Zelenka)

Tree: one healthy tree of this variety grows in a school garden ("Bajar's orchard") in Hroznová Lhota. It has a circumference of 90 cm and it is over 80 years old. It is very productive even during non-seed years.

Fruits: fruits are between 3 and 4 cm large, 10 pieces weigh 180 g. Some fruits can weigh over 30 g. The fruits are more or less uniform in size, usually conical, rarely pear-shaped. They are green, and later green-yellow; in some cases they can have orange or red cheek covering 40 % of the surface. The skin has no ribbing; it features russet lenticels, but has no larger russeting. The fruits have a distinct waxy layer, they are "frosted", and they mature even when they fall from the tree. The sepal dimple is shallow. The fruits narrow towards the stalk, which is located in a shallow, almost regular dimple. The skin is delicate and it is not resistant to pressure. The pulp is delicate, homogenous, with small sclerenchymatic cells, moderately sweet; it has an unappealing, watery taste. The fruits mature between the end of August and the second half of September. There are two harvests every three years. The fruits are somewhat prone to scabs and very prone to pressure. This variety is great for direct consumption, or to make licquers, compotes, marmalades etc.

Tree and fruits of the Little green variety from Hr. Lhota (1, 2008).

Occurrence along the Moravian-Slovakian border

Trees around Hroznová Lhota and around Kněždub bear fruits that are similar to this variety. In 2012, one tree found on the slope of the Výzkum hill (near Tasov) was subjected to dendrochronological analysis – it is 183 years old.

Fruits similar to the Little green variety on the slopes of the Výzkum hill above Tasov (2, 2011).

Fruits similar to the Little green variety on the slopes of the Šumářník nad Kněždubem hill (2, 2011).

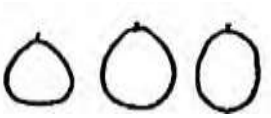
Similar types from other regions and from literature

Trees with fruits similar to the Little green variety were found in Česká středohoří in the Czech Republic, but also in the Brhlovce region in Slovakia (Bakay, 2010). The Croatian region of Dalmatia can boast trees with similar fruits as well. The largest tree with sorb apples similar to the Little green variety was found and documented in Kronberg, Germany; its stem has 4.4 m in circumference. This type is also often featured in literature. The oldest mention of a sorb apple similar to the Little green variety comes from France – it is an illustration by Jean Bourdichon (1503–1508) (see Fig.).

Depiction of a sorb apple similar to the Little green variety by Jean Bourdichon from the beginning of the 16th century (reprophoto 4, 2009).

Large tree and its fruits that are similar to the Little green variety, found in Kronberg (1, 2012).

Pomological type: Bulbous



Shapes of this variety according to the Italian typology (Bignami, 1998).

Tree: no tree of this type was found along the Moravian-Slovakian border. In Moravia, these fruits are usually found on young trees (less than 50 years old). It is possible that the tree (the largest one in that forest today) that grows in Ždánický les in the Svatá territory near Dambořice is a part of this group. This tree has a circumference of stem 2.13 m and it is more than 250 years old (see chapter VIII. 4).

Fruits: the fruits are between 3 and 5 cm large and they weigh between 10 and 25 g. They are conical or pear-shaped. The sepal dimple is shallow; the sepal itself is middle-sized or large, the bed can be protruding. The fruits mature in October or at the beginning of November, the pulp is moderately juicy, moderately sclerenchymatic, with a sweet, but bland taste.

Occurrence in Moravia

Trees of this type can be found in private gardens and parkways.

Fruits of the Bulbous type from a garden in Hodonín, from a parkways near Hvězdy, and from the Svatá territory near Dambořice, the Czech Republic (1, 2012).

Similar types from other regions and from literature

Although rare, examples of this type of service trees can be found in many places all over Europe (in Slovenia, Italy and France, for example). Micheli probably depicted this type in the 17th century. Also, the Italian Parrocchiane variety can be included in this group (see above). This type is possibly mentioned in Penzes (1956) as the Zemplinensis variety – he mentions fruits that are pear-shaped and 40 x 26 mm large.

The "Plavecov skorš" service tree from Murský vrch, Slovenia, bears fruits of the Bulbous type. (1, 2014).

A service tree with fruits that might be of the Bulbous variety fromFlorence(www.Agraria.com)

Service tree from the Austerlitz Park, Paris (1, 2009).

XII.3. Other interesting service tree varieties

There are other rare large-fruit service tree types that occasionally occur in Moravia, and especially in other places in Europe. These trees have fruits that have interesting shapes or unusually prominent russeting, or fruits that are less prone to scabs.

Yellow fruits with prominent russeting

Interesting yellow fruits with rather prominent russeting found on a large near above Kněždub (1, 2008).

Tree found in Adamovské Kochanovce on the Slovakian side of the White Carpathians (Uherkova, 2013).

Tree with russeted fruits, Kronberg, Germany (1, 2012).

Yellow-fruit service trees

Yellow-fruit service trees with spherical or conical shapes found in Žerotín, Moravia (1, 2009), in Croatia (1, 2009), and in Hessia (1, 2012).

Oval fruits

Large-fruit service trees with oval fruits that were found in Velké Pavlovice (Karber, 2009). Another large tree with a circumference of more than 3 m (bearing similar fruits) can found on the Slovakian side of Vrbovce (1, 2011). Similar oval fruits found on service trees in Florence (1, 2010).

Bronze fruits

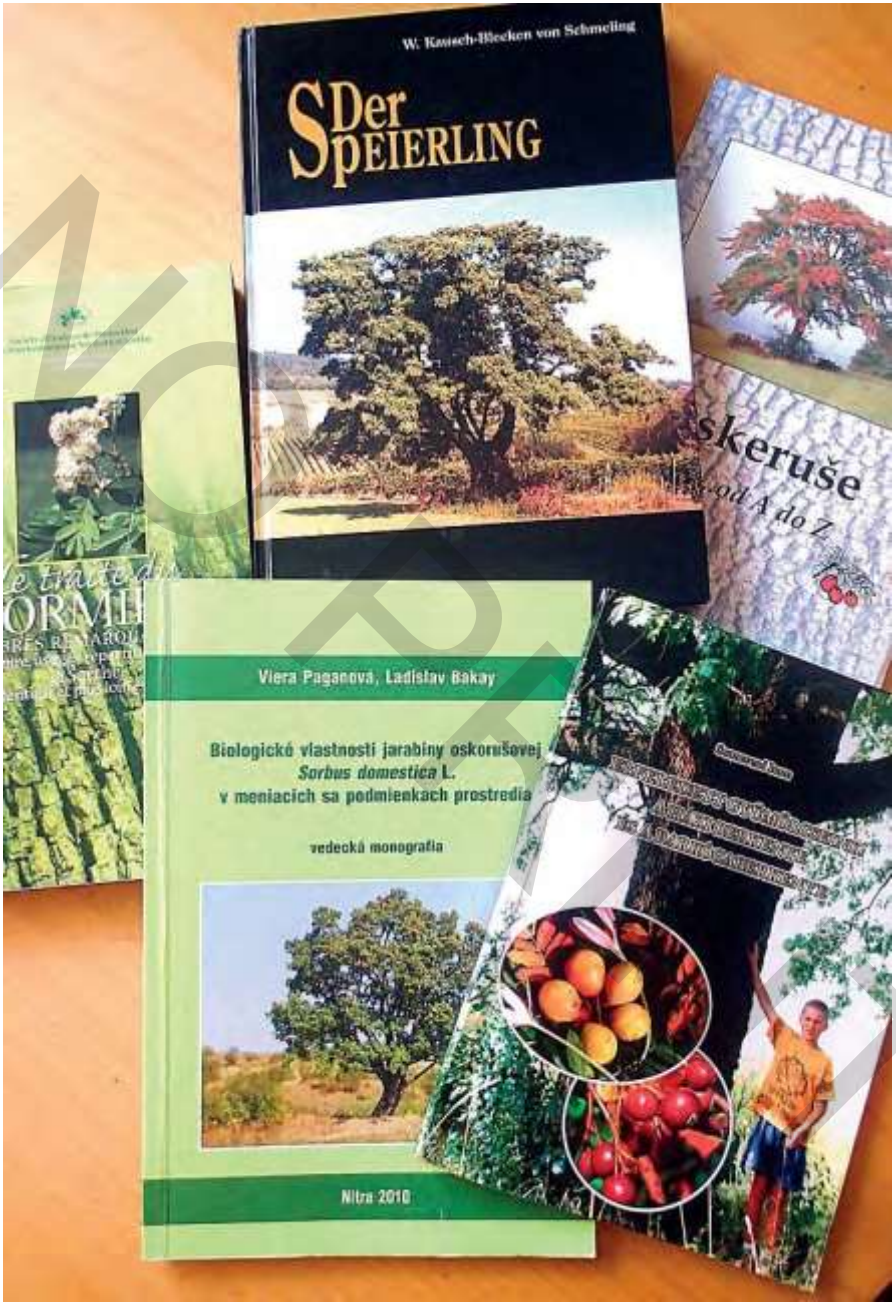
Trees that bear fruits of light bronze colour (caused by light russeting) are quite rare in Moravia. The only larger tree of this variety can be found in the gardens of the Faculty of Horticulture of the Mendel University in Lednice. They are more common in Germany (in Hessia, for instance) and in France (the Sarthe region).

Tree with bronze fruits in the gardens of the Faculty of Horticulture of the Mendel University in Lednice (2, 2007).

Bronze fruits from Hessia, Germany (1, 2012).

Conical and oval bronze fruits from the Sarthe region, France (4, 2009).

The largest documented bronze-fruit service tree grows near Kronberg, Hessia, Germany (1, 2012).



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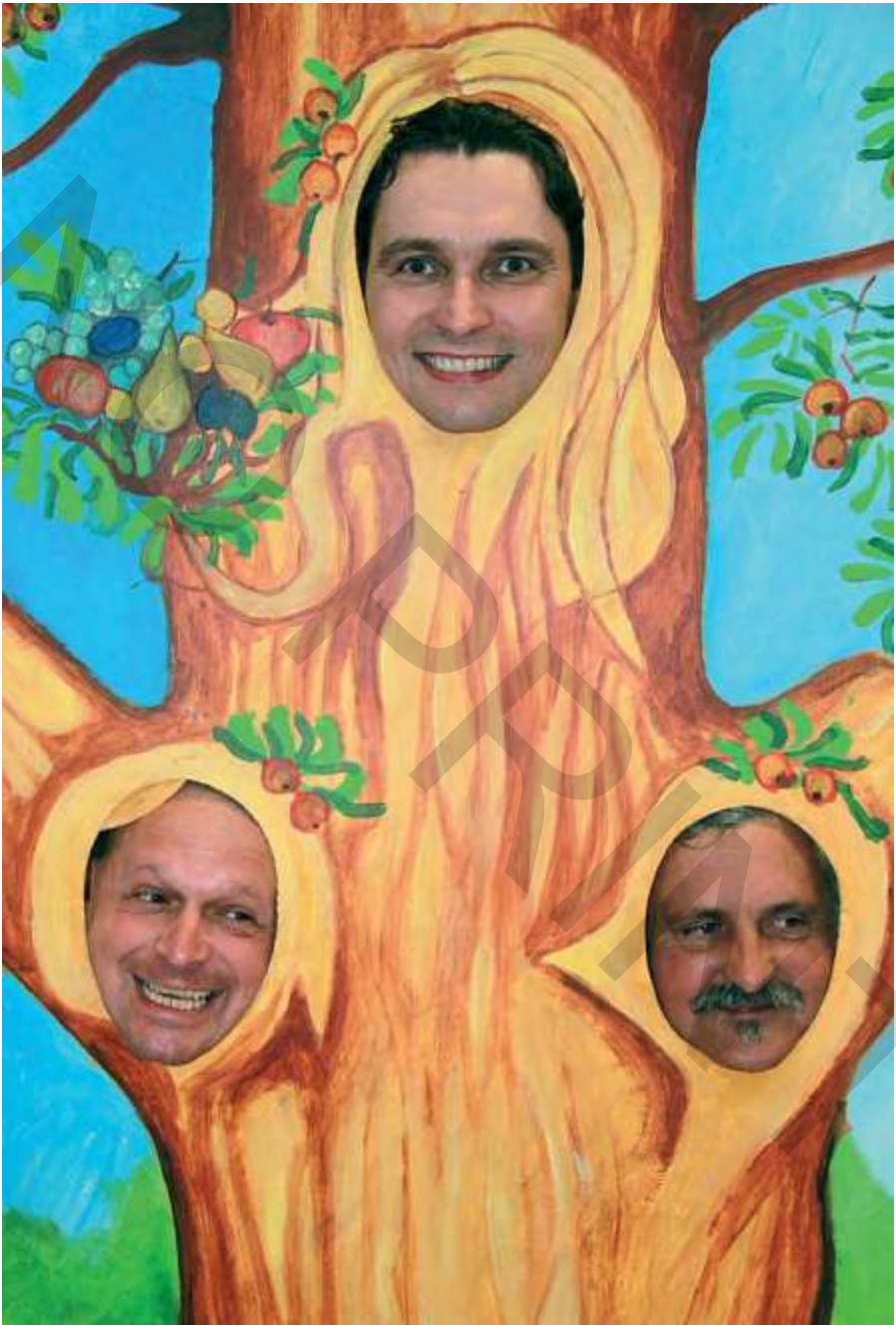


Men at a the Service-Tree Festival in Tvarožná Lhota (1, 2012)

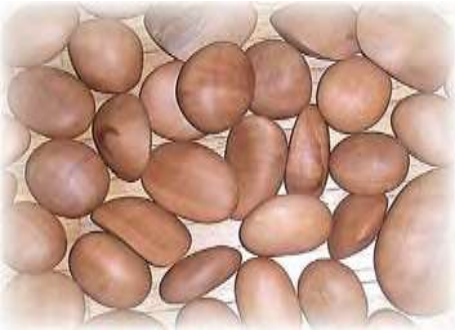
Abstrakt

Publikace **Oskeruše – strom pro novou Evropu** sumarizuje dosud známé informace o největším druhu z rodu *Sorbus*, o jeřábu oskeruši (*Sorbus domestica L.*). Kniha je určena pro širokou veřejnost, ale jistě i odborník si v ní najde zajíma- vé informace. Zároveň je podrobným návodem pro pěstitele oskeruší. Postupně čtenáře seznamuje s popisem tohoto krásného stromu, s výběrem vhodného stanoviště, s množením, růstem, řezem, ekologií, ale i nemocemi a škůdci. Mapuje dlouhou tradici pěstování tohoto druhu od antiky po současnost, s důrazem na využití plodů a dřeva. Podrobně dokládá rozšíření a užití oskeruše v jednotlivých zemích Evropy, ale i za jejími hranicemi. Volně tak navazuje na knihu prof. Kausche „Der Speierling“ (2000), kterou doplňuje a rozšiřuje o nové poznatky. Uceluje nové informace, týkající se morfologické a genetické variability druhu. Ukazuje na jedinečnou ekologii druhu a vysvětluje možné příčiny vzácnosti oskeruše v evropské krajině. Poukazuje na možnosti využití tohoto jedinečného stromu v lesnictví i v parkových a krajinářských úpravách. Nově se snaží srovnat stávající údaje o ovocnářství oskeruše a vymezit jednotlivé pomologické typy pro tento znovuobjevený ovocný druh s jejich vlastnostmi jak pro přímý konzum, tak pro další zpracování.

Abstract

The publication **Service Tree – the Tree for a New Europe** summarizes information about the largest species of the genus Sorbus – a service tree (Sorbus domestica L.). The book is intended for the general public; however, an expert may find interesting information in it too. It contains detailed instructions for growers of service trees. It gradually introduces a description of this beautiful tree to the reader with information about a selection of a suitable habitat, propagation, growth, pruning, ecological aspects, diseases and pests. It maps a long tradition of growing this species since antiquity (ancient times) to the present, with emphasis on the utilisation of its fruit and wood. It gives detailed information on the expansion and use of the service tree both in Europe and overseas. The publication loosely builds on the book “Der Speierling” by Professor Kausche (2000). It complements it and expands on it with new knowledge. It offers new information on the morphological and genetic variability of the species. It shows its ecological uniqueness and explains the possible causes for the scarcity of the service tree in the wild. It points out the possibilities of this unique tree in forestry and in park and landscape modification. It tries to compare the data that exists on growing the service tree and define the different pomological types of this rediscovered kind of fruit in terms of their properties both for direct consumption and further processing.

Fruit-bearing local variety of Chubby on the Žerotín hill near Strážnice (1,2014)



Wooden pebbles made from service-tree wood (1, 2012)

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Service tree in Radošovce, Moravian-Slovak border in White Carpathians

Back cover photo:
Two old service trees on the Žerotín hill with a vineyard near Strážnice

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