

MEMORIAL TREES IN THE CZECH LANDSCAPE

JAROMÍRA DRESLEROVÁ

Department of Forest Botany, Dendrology and Biogeocoenology, Mendel University in Brno, email: j.dreslerova@seznam.cz

Received: 16th August 2017, **Accepted:** 6th September 2017

ABSTRACT

The aim of the article is to assess the extensive database of memorial trees operated by AOPK CR (Nature Conservation Agency of the Czech Republic) and to determine the occurrence and abundance of the most monumental trees in chosen biogeographical units, (altitudinal vegetation zone, altitude, ecological series (Buček & Lacina, 2002), province, subprovince, bioregion (Culek *et al.*, 1996)) and the maximum size and age they can reach in these units.

This assessment of monumental trees at a national level was made possible based on the provision of two extensive databases containing the information about the trees (AOPK CR Database of Memorial Trees) and about the biogeographical units of the Czech Republic (Biogeographical Registry of the Czech Republic). Basic unit of both databases is cadastral area and the fact allowed to link the data and to evaluate them. The occurrence rate of memorial trees and species in individual cadastral areas and in biogeographical regions is presented in the map outputs.

Keywords: memorial trees, monumental trees, biogeographical units of the Czech Republic, species range, growth parameters

INTRODUCTION

Memorial trees are extremely important trees, their groups and alleys, which can be decreed by the resolution of nature conservation body after the fulfilment of all requirements prescribed by law. Memorial trees excel by their growth and age. They represent prominent landscape dominants, especially so the significant introduced tree species and, finally yet importantly, the historically valuable trees, which remind of memorable events or relate to various legends and fables (Reš, 1998). Alexander von Humboldt, Professor of Berlin University, was first to denote massive trees as nature monuments when he saw them at his scientific expedition to South America in 1799 – 1804 (Kyzlík *et al.*, 2003).

A majority of the memorial trees are solitaires. Solitary old trees occur in our country usually at important places, especially on road crossings, near entrances to fields or as landmarks in the landscape. People used to plant them to delimitate boundaries of individual land properties, cadastres or estates, where the trees provided shelter and shade not only to them but also to cattle (Štěpánek, 2004; Hageneder, 2003).

Dispersed vegetation creates favourable site conditions for the occurrence of fungi, invertebrates living in the cavities of decaying trees or for epiphytic mosses and lichens (Rose, 1992; Read, 1996; 2000; Alexander, 1998; Buttler *et al.*, 2001). Forest animals and

birds actively search solitary woody plants for food, as a hiding place or to nest and breed. For predatory birds, solitary trees in the landscape are necessary (Zejda, 1980; Smith *et al.*, 1992; Harding & Wall, 2000). The existence of dispersed vegetation also indirectly helps in the biological control of pests (Zejda, 1980).

The first reference to the protection of trees dates back to the Middle Ages and was closely related to forest care. One of the oldest preserved directives on forest management and penalties for damages to forest is "The Law of the Bohemian Prince Konrad Ota" from approx. 1189. Sanctions for illegal felling of trees can be found also in the Jihlava Town Law and in the book of the old lord of Rosenberg from approx. 1360. A reference to the prohibition of damaging and needless felling of trees is also in the draft of *Majestas Carolinas* by Charles IV from 1348, in Chapter 50. On the pressure of baronial council, Charles IV cancelled the *Majestas Carolinas* in 1355. In 1754, Maria Theresa issued a "Forest Order", which was at its time a progressive and meticulous regulation for the protection and management of forests (Michálek, 2005).

The history of memorial trees protection at the turn of the 19th and 20th centuries is closely connected with the emergence and work of beautifying societies in our country. On 30 October 1904, a union of Czech beautifying societies in the Kingdom of Bohemia was established in Prague ("U Choděřů"). From 1905, its name was the Union of Czech Beautifying Societies in Bohemia, Moravia and in Silesia. After the establishment of the Czechoslovak Republic, the Union changed its name to the Union of Czechoslovak Societies for Homeland Beautifying and Protection in Prague. From 1904 to the early 1950s, the Union issued an interesting periodical "The Beauty of Our Home", which reappeared thanks to the Czech Union for Nature Conservation (ČSOP), and in which we can find data on the protection of memorial trees even today (Michálek, 2005).

In 1899, Jan Evangelista Chadt Ševětínský published the first list of memorial trees in Bohemia. The same author published a registry on "Old and monumental trees in Bohemia, Moravia and in Silesia" in the journal "Český lid" (Czech People), Vol. XVII in 1908 and in a special offprint, with the description of 165 rare trees and 30 pictures. A supplemented edition with the characterizations of 320 rare trees and 160 images of monumental individuals was issued in Písek in 1913, and later as a separate chapter in the book named "History of Forests and Forestry". This list is the first comprehensive inventory of memorial trees in the Czech lands (Chadt, 1913).

Memorial trees are currently legally proclaimed pursuant to Act no. 114/1992 Sb. by the resolution of competent nature conservation body (e.g. Administration of National Park, Protected Landscape Area, empowered municipal authorities etc.). The memorial trees are included in the publicly accessible central list of nature conservation administered by AOPK ČR (Reš, 1998). The current directory of decreed "Memorial Trees" was gradually issued as part of the edition "Protected Areas of the Czech Republic" (Mackovčín & Sedláček, 1999-2009). The ensemble of memorial trees is not closed to extremely valuable introduced tree species either (Reš & Štěrbá, 2010).

Another source dealing with the current monumental and memorial trees is the work compiled by the collective of authors Tábor *et. al.* (1998, 2001, 2002, 2003, 2004, 2005) who focused namely on evaluating the occurrence of memorial trees registered in the AOPK CR database in individual regions (administrative regions and districts) and on selecting suitable specimens determined for the conservation of genetic resources of these memorial trees.

Massive and memorial trees at a regional level are mentioned in a number of tourist guides relating to regional history and geography (Modrý, 2004; Kubačka & Kubáčková, 2005; Hrubá & Valentová, 2005; Hrušková, 2008; a.o.) or in publications evaluating the memorial

trees as objects of folklore character, trees with legends and fables etc. (Hrušková & Turek *et. al.*, 1986; 1995; 1999; 2001; 2005; Hrušková & Turek, 2003).

Most countries in Europe have the protection of monumental trees enacted directly by legislation or by local decrees. Characteristics or criteria classifying the trees as significant are identical in a majority of countries and are in line with the above presented definition of memorial trees. Thus, memorial trees are considered natural cultural heritage, which has to be protected and preserved (ZTV-Baumpflege, 1992; Domínguez, 2010; Circulaire ministérielle, 2008; Ustawa o ochronie przyrody, 2004; Zákon o ochraně přírody a krajiny, 2003; Tutela e valorizzazione degli alberi monumentali, 2005; a.o.). For example, one of the first laws on nature conservation in Sweden from 1909 included the protection of trees. In Austria, a similar law has existed since 1913, in Italy since 1939 and in Poland since 1934 (Symonides, 2007; Mittmannsgruber, 2011; Anonymus, 1998).

MATERIAL AND METHODS

The assessment of monumental trees at a national level was made possible by using two extensive databases containing information on memorial trees (AOPK CR Database of memorial trees) and on biogeographical units of the Czech Republic (Biogeographical Registry of the Czech Republic). Basic unit of the two databases is cadastral area and this made it possible to link the available data and evaluate them.

The occurrence rate of memorial trees and species in individual cadastral areas and in biogeographical regions is presented in map outputs. The maps were plotted in the ArcMap programme. The base map of bioregions was taken over from the Biogeographical Division of the Czech Republic (Culek *et. al.*, 1996).

Evaluation of the Database of Memorial Trees of the Czech Republic

The Central List AOPK CR includes the characterization, positioning, legal and technical documentation of memorial trees, their buffer zones, and a list of contractually protected memorial trees proclaimed pursuant to § 39 of Act no. 114/1992 Sb. on nature conservation and landscape protection, occurring in the territory of the Czech Republic.

On 31 December 2006, AOPK CR provided a shortened extract with fundamental data on the memorial trees – a so-called AOPK CR database of memorial trees - containing basic dendrological characteristics, GPS coordinates, health condition and reason for protection, and other information to each memorial tree. For the purpose of this study, we used the data on girth, height, crown size (width and height, namely in pedunculate oak *Quercus robur*) and age of memorial trees.

Biogeographical registry

Data from the AOPK CR database of memorial trees were linked with the data from the Biogeographical Registry. The assessment of memorial trees was focused primarily on growth dimensions, and on the abundance of these trees in the individual altitudinal vegetation zones and other units of the biogeographical division of the landscape (bioregions).

The Biogeographical Registry contains landscape typification in cadastral areas and provides for creating an overall conception about the natural condition of biogeocoenoses in the landscape, which is a good basis for the comparison of changes occurring due to human activities (Zlatník, 1973). The Registry includes data about the distribution of superstructural units of biogeocoenological landscape typification (altitudinal vegetation zones, hydric and trophic series) in ca. 12,900 cadastral areas of the Czech Republic.

Basic element of the Biogeographical Registry is cadastral area. Affiliation to the superstructural units of biogeocoenological typification (Buček & Lacina, 2002) was coded for each cadastral area, which is characterized by three data in the following order:

Code of altitudinal zonality – Code of trophic series – Code of hydric series

Since a greater part of the cadastral areas are heterogeneous in terms of superstructural units, the coding had to be adapted and include characteristic combinations of linked altitudinal vegetation zones (Tab. 1) (Buček & Lacina, 1988).

Table 1: Coding units of altitudinal vegetation zonality (Buček & Lacina, 1988)

AVZ - 1	1 - Oak 100%
AVZ - 2	2 - Oak 70-90% (Beech-oak 1-30%)
AVZ - 3	3 - Oak 50-70% (Beech-oak 30-50%)
AVZ - 4	4 - Beech-oak 100%
AVZ - 5	5 - Beech-oak 50-70% (Oak 30-50%)
AVZ - 6	6 - Beech-oak 50-70% (Oak-beech 30-50%)
AVZ - 7	7 - Oak-beech 100%
AVZ - 8	8 - Oak-beech 50-70% (Beech-oak 30-50%)
AVZ - 9	9 - Oak-beech 50-70% (Beech 30-50%)
AVZ - 10	10 - Beech 100%
AVZ - 11	11 - Beech 50-70% (Oak-beech 30-50%)
AVZ - 12	12 - Beech 50-70% (Fir-beech 30-50%)
AVZ - 13	13 - Oak coniferous 100%
AVZ - 14	14 - Oak coniferous 50-70% (Oak-beech 30-50%)
AVZ - 15	15 - Beech 30-50% (Oak coniferous 30-70%)
AVZ - 16	16 - Oak coniferous 50-70% (Fir-beech 30-50%)
AVZ - 17	17 - Fir-beech 100%
AVZ - 18	18 - Fir-beech 50-70% (Beech 30-50%)
AVZ - 19	19 - Fir-beech 50-70% (Beech 30-50%, Spruce-fir-beech 1-30%)
AVZ - 20	20 - Fir-beech 70-90% (Spruce-fir-beech 1-30%)
AVZ - 21	21 - Fir-beech 50-70% (Spruce-fir-beech 30-50%)
AVZ - 22	22 - Spruce-fir-beech 50-70% (Fir-beech 30-50%)
AVZ - 23	23 - Fir-beech 50-70% (Spruce-fir-beech 30-50%, Spruce 1-20%)
AVZ - 24	24 - Spruce-fir-beech 50-70% (Spruce 30-50%)
AVZ - 25	25 - Spruce-fir-beech 50-70% (Spruce 30-50%, 1 - 20% Dwarf-pine and Alpine)
AVZ - 26	26 - Spruce-fir-beech 100%

Altitudinal vegetation zonality of cadastral areas of the Czech Republic is characterized by 26 coding symbols, of which 7 are homogeneous and 19 are heterogeneous. The content of heterogeneous codes for Altitudinal Vegetation Zones (AVZ) 1 - 9 was defined so that it features the predominant altitudinal zone (50 – 70 % of cadastre area) and the linking altitudinal zone (30 – 50 % of cadastre area) (Buček & Lacina, 1988).

Higher level of biogeographical division of the Czech Republic is represented by biogeographical regions (Culek *et. al.*, 1996). Bioregions are in terms of biota original parts of landscape and have to meet the following criteria: The given territory has a specific combination of the groups of biogeocoene types and types of biochores. It features typical geoelements, migrants and relicts. In the flat relief, the delimited territory has to belong to the same sea drainage area. The entire territory has to be spatially compact and its area has to

be larger than 100 km² (Culek *et al.*, 1996). The Czech territory is crossed by the boundaries of two biogeographical provinces – Pannonian and that of Central European deciduous forests (Meusel, 1965), which are further divided into four subprovinces (Buček *et al.*, 1992). In the territory of the Czech Republic, 90 bioregions are distinguished (Culek *et al.*, 1996). The assessment of memorial trees consisted in the evaluation of growth parameters and occurrence rate of individual species in the bioregions, provinces and subprovinces.

RESULTS

Evaluation of the species spectrum and growth of memorial trees

The extensive AOPK CR database of memorial trees included 26,262 trees to the date of 31 December 2006. Representation of individuals recorded in the cadastral areas is presented in Map Attachment No. 1. (see Appendix).

There are 5,479 items, into which the trees are divided according to their formation in the terrain. To the mentioned date, the database included 14,889 trees in linear formations (239 items), 3,474 trees (3,462 items) registered as solitaires and 7,704 trees (1,770 items) occurring in the tree groups. The smallest number of memorial trees (191 trees in 4 items) falls into the "stand" category. All data on numbers should be considered indicative since the total number of trees is continuously changing.

Species spectrum of memorial trees

The database of memorial trees includes 124 taxa (species, cultivars and hybrids). Autochthonous are 50 species and 14 cultivars. The remaining 60 species are allochthonous in the Czech Republic. The most abundant species are as follows: small-leaved linden (*Tilia cordata*) with 8,798 trees (1,737 items) and pedunculate oak (*Quercus robur*) with 4,050 trees recorded in 1,271 items. More than a thousand of trees decreed as memorial trees have horse chestnut (*Aesculus hippocastanum*) with 2,277 individuals in 95 items, large-leaved linden (*Tilia platyphyllos*) with 1,850 individuals in 590 items, European ash (*Fraxinus excelsior*) with 1,295 individuals in 155 items and sycamore maple (*Acer pseudoplatanus*) with 1,005 individuals in 173 items (Map Attachment No. 2 - see Appendix).

Growth parameters of recorded tree species

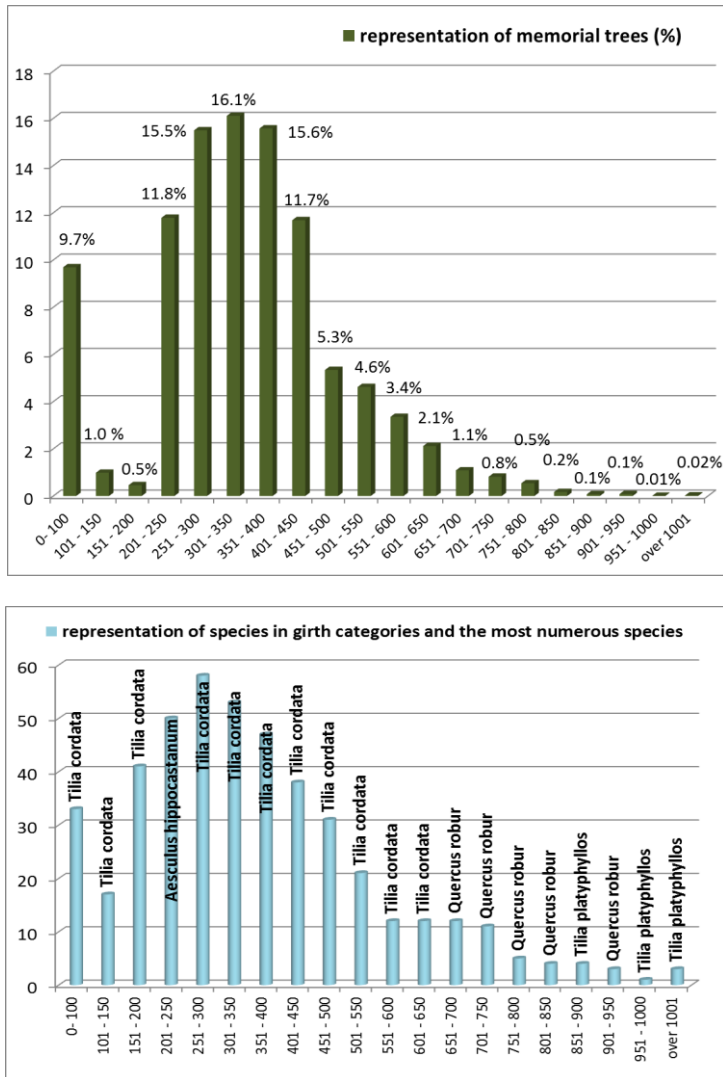
The range of girths gauged at breast height is 100 cm – 1,252 cm. According to the database, the most monumental trees in the Czech Republic are two large-leaved lindens (*Tilia platyphyllos*) – one is the Vejdova linden at Pastviny (girth 1,225 cm) and the second one is the Sudslavická linden (girth 1,150 cm). Other giant trees include the Tatrovická linden – small-leaved linden (*Tilia cordata*) (girth 1,122 cm) near Tatrovice in the Sokolov district, and the Žižka's oak – pedunculate oak (*Quercus robur*) (girth 1,003 cm) in Náměšť nad Oslavou. A leading representative of conifers in the database of memorial trees of the Czech Republic is the giant sequoia (*Sequoiadendron giganteum*) in Chabaně (girth 612 cm), which is followed by a European larch (*Larix decidua*) near Petrovice (girth 550 cm) and a Norway spruce (*Picea abies*) in the Slavická game preserve (girth 520 cm).

Interesting are dimensions of the field maple (*Acer campestre*) in Čížkov (girth 470 cm), the Adamcova service tree (*Sorbus domestica*) (girth 460 cm) or the Pastýřova pear (*Pyrus communis*) (girth 435 cm). Monumental conifers include the Vopařilova fir (*Abies alba*) (girth 450 cm) or common yews (*Taxus baccata*) at Krompach (girth 460 cm) (Map Attachment No. 3 - see Appendix).

The highest representation among the memorial trees have individuals with girths ranging from 300 – 350 cm (16.1 %) (Fig. 1). As to the diversity of species composition, the most

abundant is the girth category of 250 - 300 cm with 58 species. Similarly as in a majority of girth categories, most abundant in this category are the specimens of small-leaved linden (*Tilia cordata*). Exceptional is the girth category of 201 – 250 cm, which is dominated by individuals of horse chestnut (*Aesculus hippocastanum*). Most abundant in larger girth categories (651 - 850 cm) are individuals of pedunculate oak (*Quercus robur*) and the largest girth category (851 cm and more) includes predominantly the specimens of large-leaved linden (*Tilia platyphyllos*).

Fig. 1: Representation of memorial trees and species in girth categories



Maximum tree heights of individual species range from about 2 m up to giants tall over 55 m. The tallest trees in the database are conifers. The largest specimen is a European larch (*Larix decidua*) called Larch the Trey in Habrůvka with a total height of 58 m and girth

448 cm, which is followed by the Fremuth's silver fir (*Abies alba*) near the village of Čerchov, with a height of 55 m and girth 386 cm. The first broadleaved representatives, which succeeded in making their way among the tallest trees, are London planes (*Platanus x acerifolia*). The tallest individual is the Plane at St. Anne with a height of 47 m and girth 571 cm; the second one is a plane in Běstvína with a height of 46 m and girth 565 cm. The database also contains specimens of black poplar (*Populus nigra*) and large-leaved linden (*Tilia platyphyllos*) with a height of 45 m.

Occurrence of memorial trees in units of biogeographical division

Occurrence of memorial trees in altitudinal vegetation zones

Most decreed memorial trees fall in the Beech altitudinal vegetation zone (AVZ 10, 18.2 %). High numbers of memorial trees occur also in the Oak-Beech (AVZ 7, 17.2 %) and the Fir-Beech (AVZ 17, 12.5 %) altitudinal vegetation zones (Fig. 2).

The species most abundant in the concerned units of altitudinal vegetation zonality is small-leaved linden (*Tilia cordata*), occurring from the Oak (AVZ 7) to the Fir-Beech (AVZ 12) altitudinal vegetation zones, and pedunculate oak (*Quercus robur*) occurring most in five AVZ units, of which its greatest representation is in the Beech-Oak (AVZ 4) and in the Beech (AVZ 10) altitudinal vegetation zones including the Oak-Coniferous variant (AVZ 13) (Fig. 3).

Interesting is that the most abundant tree species in the Oak altitudinal vegetation zone is London plane (*Platanus x acerifolia*, AVZ 1) and service tree (*Sorbus domestica*, AVZ 2), which are complemented by large-leaved linden (*Tilia platyphyllos*, AVZ 3) (Fig. 3).

The below table presents the maximum growth values and age reached by memorial trees in the respective coding units of the given altitudinal vegetation zone (Tab. 4). Individuals with the largest girth occur in the Fir-Beech altitudinal vegetation zone (*Tilia platyphyllos* with 1,252 and 1,150 cm, AVZ 17 and AVZ 18), in the Beech altitudinal vegetation zone (*Tilia cordata* with 1,122 cm, AVZ 12) and in the Oak-Beech altitudinal vegetation zone (*Quercus robur* with 1,003 cm, AVZ 7). The oldest specimens occur on the dividing line between the Beech-Oak and Oak-Beech altitudinal vegetation zones (AVZ 6, 7) and between the Oak-Beech and Beech altitudinal vegetation zones (AVZ 9, 10). The oldest tree at the highest altitude (*Tilia platyphyllos*) occurs in the Fir-Beech altitudinal vegetation zone (AVZ 17). The data on age should be considered of informative value only as they are often estimated or taken over from local historical sources.

Fig. 2: Representation of memorial trees in altitudinal vegetation zones in percent

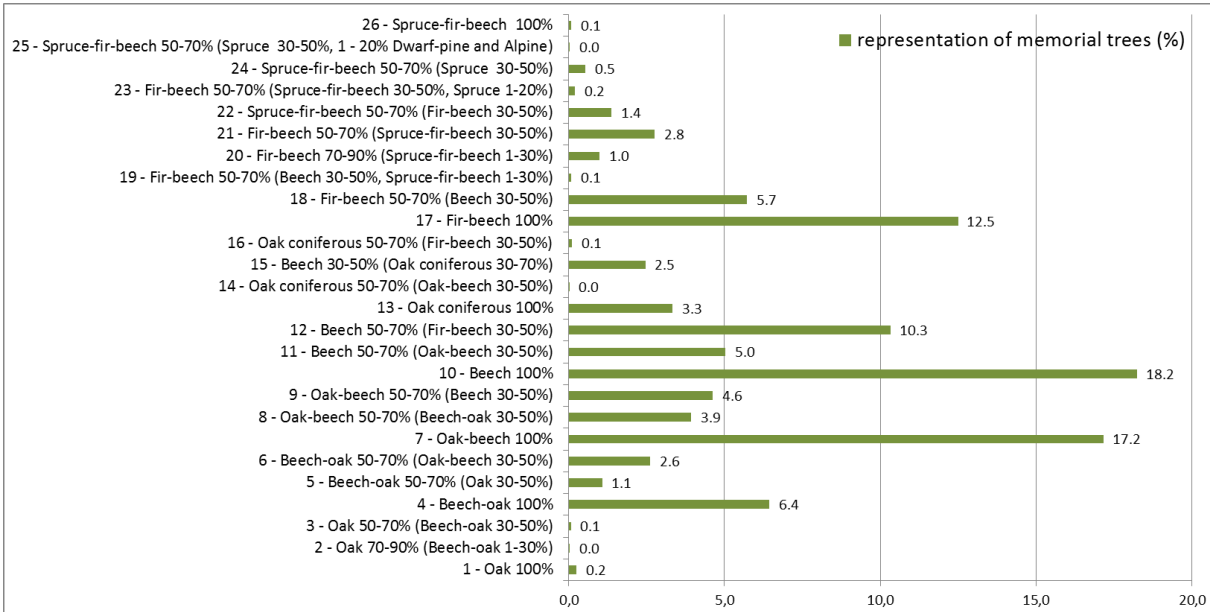


Fig. 3: Species diversity in altitudinal vegetation zones and representation of the most abundant species (%)

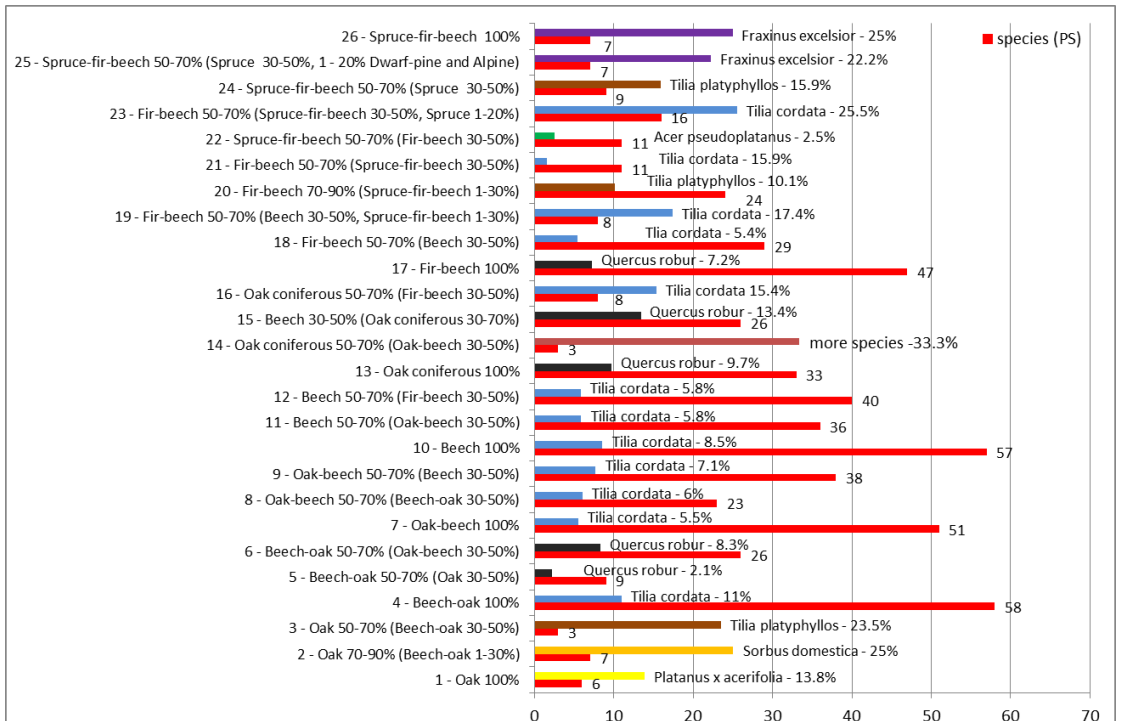


Table 4: Growth characteristics of trees in altitudinal vegetation zones

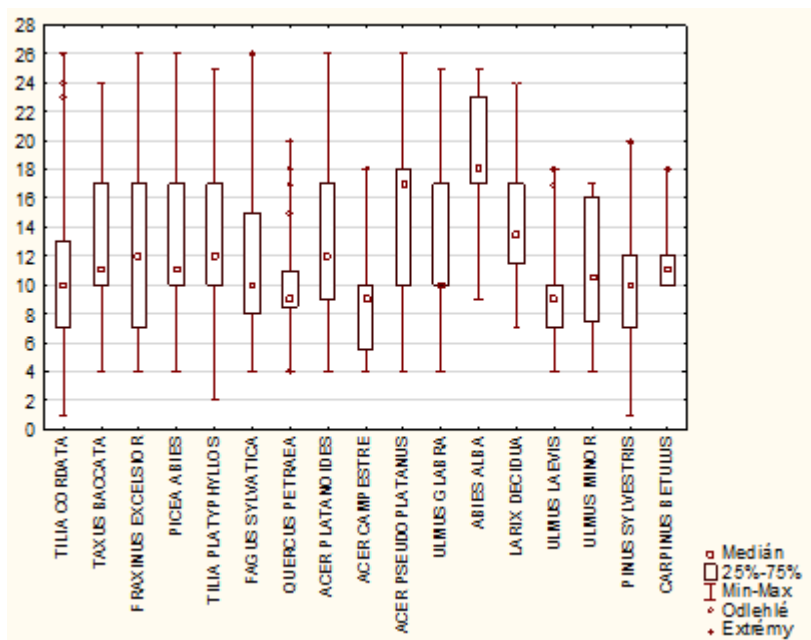
AVZ	Altitudinal Vegetation Zone	Girth		Height		Age		Girth		Height		Age	
		diameter	Stand. deviat.	diameter	Stand. deviat.	Stand. deviat.	Age	biggest	species	highest	eldest	species	Age
AVZ - 1	1 - Oak 100%	317	229.3	10	14.27	75	100.63	675	Populus nigra	35	300	300	Populus alba
AVZ - 2	2 - Oak 70-90% (Beech-oak 1-30%)	351	174.72	17	7.18	148	136.15	710	Quercus robur	32	450	450	Quercus robur
AVZ - 3	3 - Oak 50-70% (Beech-oak 30-50%)	343	172.53	18	4.5	289	247.21	565	Quercus robur	25	900	900	Tilia platyphyllos
AVZ - 4	4 - Beech-oak 100%	355	124.73	17	9.37	138	106.97	800	Populus nigra	47	500	500	vice druhu
AVZ - 5	5 - Beech-oak 50-70% (Oak 30-50%)	353	145.38	17	12.29	129	115.03	685	Tilia cordata	38	400	400	Tilia cordata
AVZ - 6	6 - Beech-oak 50-70% (Oak-beech 30-50%)	396	132.82	17	9.93	186	141.54	800	Quercus robur	41	1000	1000	Quercus robur
AVZ - 7	7 - Oak-beech 100%	365	134.97	17	10.91	117	129.18	1003	Quercus robur	45	1000	1000	Quercus robur
AVZ - 8	8 - Oak-beech 50-70% (Beech-oak 30-50%)	350	126.03	15	10.73	161	115.74	800	Tilia cordata	41	600	600	Tilia platyphyllos
AVZ - 9	9 - Oak-beech 50-70% (Beech 30-50%)	359	128.66	17	11.67	142	136.93	900	Quercus robur	45	1000	1000	Quercus robur
AVZ - 10	10 - Beech 100%	393	144.29	18	10.97	171	144.15	940	Tilia platyphyllos	46	1000	1000	Quercus robur
AVZ - 11	11 - Beech 50-70% (Oak-beech 30-50%)	346	139.6	17	12.14	152	120.3	953	Tilia platyphyllos	58	700	700	Taxus baccata
AVZ - 12	12 - Beech 50-70% (Fir-beech 30-50%)	385	150.79	17	11.86	153	135.35	1122	Tilia cordata	47	1000	1000	Tilia platyphyllos
AVZ - 13	13 - Oak coniferous 100%	397	159.79	19	9.99	160	136.38	853	Tilia cordata	38	500	500	Tilia platyphyllos
AVZ - 14	14 - Oak coniferous 50-70% (Oak-beech 30-50%)	426	148.21	13	11.68	205	261.87	522	Quercus robur	23	500	500	Tilia cordata
AVZ - 15	15 - Beech 30-50% (Oak coniferous 30-70%)	414	137.18	20	9.59	188	129.63	792	Quercus robur	36	500	500	Quercus robur
AVZ - 16	16 - Oak coniferous 50-70% (Fir-beech 30-50%)	391	165.71	18	11.64	131	131.25	690	Populus nigra	33	320	320	Tilia cordata
AVZ - 17	17 - Fir-beech 100%	428	159.67	19	11.36	176	150.15	1252	Tilia platyphyllos	49	1000	1000	Tilia platyphyllos
AVZ - 18	18 - Fir-beech 50-70% (Beech 30-50%)	381	141.61	17	12.25	152	129.01	1150	Tilia platyphyllos	47	700	700	Taxus baccata
AVZ - 19	19 - Fir-beech 50-70% (Beech 30-50%, Spruce-fir-beech 1-30%)	439	155.89	23	10.99	172	99.66	713	Tilia platyphyllos	42	300	300	Tilia platyphyllos
AVZ - 20	20 - Fir-beech 70-90% (Spruce-fir-beech 1-30%)	381	161.79	19	10.83	173	141.56	855	Tilia platyphyllos	36	600	600	Tilia cordata
AVZ - 21	21 - Fir-beech 50-70% (Spruce-fir-beech 30-50%)	379	175.24	24	12.43	167	103.72	843	Tilia cordata	55	400	400	Tilia cordata
AVZ - 22	22 - Spruce-fir-beech 50-70% (Fir-beech 30-50%)	404	101.57	25	7.94	170	104.55	620	Tilia platyphyllos	46	300	300	more species
AVZ - 23	23 - Fir-beech 50-70% (Spruce-fir-beech 30-50%, Spruce 1-20%)	426	138.23	23	12.78	223	139.13	806	Tilia platyphyllos	42	700	700	Tilia platyphyllos
AVZ - 24	24 - Spruce-fir-beech 50-70% (Spruce 30-50%)	415	124.77	24	10.93	214	77.15	695	Tilia platyphyllos	45	500	500	Fagus sylvatica
AVZ - 25	25 - Spruce-fir-beech 50-70% (Spruce 30-50%, 1 - 20% Dwarf-pine and Alpine)	429	179.74	25	6.25	179	127.91	796	Tilia platyphyllos	34	350	350	Tilia platyphyllos
AVZ - 26	26 - Spruce-fir-beech 100%	443	93.99	25	4.38	174	54.69	650	Tilia cordata	35	250	250	Tilia cordata

Individuals in higher altitudinal vegetation zones, from the Oak-Coniferous altitudinal vegetation zone (AVZ 14) succeed in reaching the largest mean girth and height. Trees on the transition between the Oak (AVZ 3), Oak-Coniferous (AVZ 14) and Fir-Beech (AVZ 23) altitudinal vegetation zones reach the highest mean age (Tab. 4).

European ash (*Fraxinus excelsior*) reaches the greatest range of occurrence of all memorial trees from the Oak-Beech (AVZ 7) up to the Fir-Beech (AVZ 17) altitudinal vegetation zones. Of other species, a similar range of occurrence have smooth elm (*Ulmus minor*) (AVZ 7-AVZ 16) and Norway maple (*Acer platanoides*) (AVZ 9-AVZ 17). Visible is the boundary of the occurrence of lowland species and species growing in higher elevations, e.g. representatives of field maple (*Acer campestre*), sycamore maple (*Ulmus glabra*) or silver fir (*Abies alba*).

The lowest variability of the occurrence in altitudinal vegetation zones is that of European hornbeam (*Carpinus betulus*) and sessile oak (*Quercus petraea*). European hornbeam (*Carpinus betulus*) is proclaimed a memorial tree only in the Beech altitudinal vegetation zone (AVZ 10-AVZ 12). Registered representatives of sessile oak (*Quercus petraea*) occur on the transition between the Oak-Beech and Beech altitudinal vegetation zones (AVZ 9-AVZ 11) (Fig. 4).

Fig. 4: Representation of some tree species in altitudinal vegetation zones



Based on the average values of growth characteristics, we can state that the best doing in terms of the greatest mean girth are individuals of large-leaved linden (*Tilia platyphyllos*) in cadastral areas predominated by the Spruce-Fir-Beech altitudinal vegetation zone (AVZ 22).

Individuals of Norway spruce (*Picea abies*) and silver fir (*Abies alba*) reach the greatest mean height in cadastral areas predominated by the Fir-Beech (AVZ 23) altitudinal vegetation zone. The AVZ 23 coding unit features also memorial trees with the average highest age thanks to large-leaved linden (*Tilia platyphyllos*, 405 years) and common yew (*Taxus baccata*, 400 years) (Tab. 5).

Table 5: The highest mean growth characteristics and age of some tree species in altitudinal vegetation zones

SPECIES	Altitudinal Vegetation Zone (AVZ)	GIRT - diameter (cm)	Altitudinal Vegetation Zone (AVZ)	HEIGHT - diameter (m)	Altitudinal Vegetation Zone (AVZ)	AGE - diameter (years)
ABIES ALBA	24	306	23	42	24	195
ACER CAMPESTRE	18	313	23	27	9	221
ACER PLATANOIDES	26	446	9	25	9	153
ACER PSEUDOPLATANUS	23	475	9	35	23	275
CARPINUS BETULUS	10	291	10	17	10	205
FAGUS SYLVATICA	23	511	23	27	24	258
FRAXINUS EXCELSIOR	15	477	9	28	15	273
LARIX DECIDUA	20	455	12	30	15	135
PICEA ABIES	21	427	18	46	24	270
PINUS SYLVESTRIS	15	331	15	18	4	228
QUERCUS PETRAEA	11	435	7	24	10	226
TAXUS BACCATA	9	306	19	13	23	400
TILIA CORDATA	26	572	26	28	22	283
TILIA PLATYPHYLLOS	25	645	19	30	23	404
ULMUS GLABRA	18	512	17	40	18	250
ULMUS LAEVIS	11	348	9	35	9	100
ULMUS MINOR	8	506	17	27	8	200

Occurrence of memorial trees in the units of biogeographical division (Culek *et. al.*, 1996)

By combining the above mentioned two databases, the Biogeographical Registry and the AOPK CR database of memorial trees, the information about the memorial trees could be extended to include data on the abundance of individual tree species and species diversity of memorial trees in the individual units of Biogeographical division of the Czech Republic (Culek *et. al.*, 1996). From the biogeographical point of view, the Czech Republic belongs in the biome of deciduous broadleaved forests (Hendrych, 1984), which is divided into two biogeographical provinces – Pannonian and that of Central European deciduous forests.

To the date of 31 December 2006, i.e. to the date of the last update of the used AOPK CR database of memorial trees, there were only 187 memorial trees (in 44 items) of 12 species (5 allochthonous) belonging in the Pannonian province in the Czech territory with one distinguished North-Pannonian subprovince. The most abundant tree species are pedunculate oak (*Quercus robur*) and small-leaved linden (*Tilia cordata*). Memorial trees with the largest girth are pedunculate oak (*Quercus robur*) with 710 cm and London plane (*Platanus x acerifolia*) with 696 cm, the height of which (41 m) ranks the latter also to the tallest trees in this province. The age of trees ranges from 100 – 900 years, the oldest specimens being a 900-year old large-leaved linden (*Tilia platyphyllos*) and a 450-year old pedunculate oak (*Quercus robur*).

A majority of memorial trees, i.e. 26,075 individuals (107 species, hybrids and cultivars, of which 52 allochthonous species) falls in the province of Central European deciduous forests. The province is further divided into 3 subprovinces: Hercynian subprovince with 12 species, hybrids and cultivars (23,614 individuals), Polonian subprovince with 22 species (140

individuals) and West-Carpathian subprovince with 45 species (2,319 individuals). The species most represented in all subprovinces are once again individuals of small-leaved linden (*Tilia cordata*) and pedunculate oak (*Quercus robur*).

As to girth, the most monumental in the Hercynian subprovince are individuals of large-leaved linden (*Tilia platyphyllos*) with 1,225 cm and 1,150 cm or a small-leaved linden (*Tilia cordata*) with 1,122 cm and a pedunculate oak (*Quercus robur*) with 1,003 cm. In the Polonian subprovince, an individual with the largest girth is a London plane (*Platanus x acerifolia*) with 790 cm, and in the West-Carpathian subprovince, the most monumental specimens are a sessile oak (*Quercus petraea*) with 900 cm and a small-leaved linden (*Tilia cordata*) with 813 cm.

In the Polonian subprovince, the greatest tree height was recorded in a London plane (*Platanus x acerifolia*) with 38 m. In the Hercynian subprovince, the tallest trees are conifers – a European larch (*Larix decidua*) with 58 m and a silver fir (*Abies alba*) with 55 m. The tallest trees in the West-Carpathian subprovince are conifers too – a Norway spruce (*Picea abies*) with 47 m and a silver fir (*Abies alba*) with 45 m.

The oldest individuals with an expected age over 1,000 years occur in the Hercynian subprovince – pedunculate oaks (*Quercus robur*) and large-leaved lindens (*Tilia platyphyllos*). The oldest individuals in the Polonian subprovince, the age of which is estimated at mere 400 years include a pedunculate oak (*Quercus robur*) and a small-leaved linden (*Tilia cordata*). The oldest individual in the West-Carpathian subprovince is a common yew (*Taxus baccata*) aged approx. 1,000 years.

Bioregions

The lowest unit distinguished in the above-characterized individual division is a biogeographical region (bioregion). In the Czech Republic, there are 91 bioregions with at least one proclaimed memorial tree. Most individuals are registered in the bioregion of Velké Meziříčí (5.5 %), in the Šumava bioregion (5.5 %) or for example in the bioregion of Svitavy (5.2 %). A comprehensive survey of memorial trees in the bioregions with growth characteristics and age is presented in Tab. 6. Representation of individuals recorded in the bioregions is presented also in Map Attachment No. 4. Species diversity of memorial trees in the individual bioregions is presented in Map Attachment No. 5.

Table 6: Representation of memorial trees in bioregions (above 2 %)

BIOREGION	percent		number		the most numerous		GIRT		HEIGHT		AGE		species
	%	species	species	pieces	smallest	biggest	smallest	highest	youngest	oldest			
1.50 Velkomoravský bioregion	5.5	16	Tilia cordata	44	160	1003 - Žžkův dub	6	45	50	1000	Quercus robur		
1.62 Šumavský bioregion	5.5	19	Tilia platyphyllos	45	90	957 - Husova lípa	6	45	80	700	Tilia platyphyllos		
1.39 Svitavský bioregion	5.2	24	Tilia cordata	56	120	953 - Lpa ve Velkých Opatovících	10	44	80	600	Tilia platyphyllos		
1.19 Křivoklátský bioregion	4.5	19	Quercus robur	39	112	710 - Dub u Velkého rybníka	10	38	100	480	Quercus robur		
1.23 Jevišovický bioregion	3.6	10	Quercus robur	34	121	670 - Dvořáta	10	45	100	500	Tilia cordata		
3.1 Žďárnicko-Litavický bioregion	3.4	20	Tilia cordata	23	155	900 - Obořív dub	7	38	100	600	Quercus petraea		
1.20 Slapský bioregion	3.3	15	Tilia cordata	51	141	684 - Lpa ve Smolelech	9	33	100	600	many stress		
1.61 Českoselský bioregion	3.0	9	Tilia platyphyllos	12	150	620 - Lesenská lípa (u kostele)	8	44	80	400	Tilia platyphyllos		
1.5 Českokobrodský bioregion	3.0	28	Tilia cordata	63	123	380 - Dub v Satalicích bažantnici	5	46	100	500	Tilia cordata		
1.27 Tachovský bioregion	2.6	10	Tilia platyphyllos	12	80	780 - Lpa u hřbitova	13	39	80	500	Quercus robur		
1.28 Přeženský bioregion	2.5	17	Tilia cordata	24	122	760 - Žžkův dub	12	36	100	730	Quercus robur		
3.4 Hranický bioregion	2.4	21	Tilia cordata	23	129	813 - Lpa v Malhoticích	10	47	80	430	Quercus robur		
1.60 Hornoslavkovský bioregion	2.3	12	Tilia platyphyllos	17	179	910 - Hroznatova lípa	14	41	120	450	Tilia platyphyllos		
1.22 Posázavský bioregion	2.3	24	Tilia cordata	116	119	752 - Lpa u Thunovského letohrádku	10	53	100	900	Taxus baccata		
1.24 Brněnský bioregion	2.2	17	Tilia cordata	13	113	650 - Patany v Trnitě	12	39	50	400	Tilia cordata		
1.48 Havlíčkovobrodský bioregion	2.2	15	Tilia cordata	37	90	785 - Lpa u Rozsochalce	9	41	80	530	Quercus robur		
1.6 Medobrodslavský bioregion	2.0	28	T. cordata, Q. robur	41	129	800 - Komárovický topol	7	35	100	500	Quercus robur		

DISCUSSION

Reasons for many important trees having been preserved in the territory of the Czech Republic should be searched in the history and development of the country, in which a close relationship between humans and trees has been established since the times immemorial. Already the old Slavonic nations believed that trees possess divine power and this is why they were considered sacred (Martičko *et al.*, 2010). Since those times, many customs and traditions have been preserved related not only to trees but also to their planting (upon the birth of son, building of a house and also on various important events). In the past times, these trees were of symbolic character, could not be cut and usually reached a very high age (Hrušková & Ludvík, 2006). This closely relates to places where we find the monumental and memorial trees today most frequently. As a rule, they accompany historical buildings (castle, mansion, church), or they grow as solitaires in the landscape or in the forest as the remnants of ancient trails or land boundaries (Chadt, 1913). Another possibility for the occurrence of memorial trees is within the formations of varying size such as alleys or remainders of primeval forests. This is the conception on which the division of registered items of memorial trees in the AOPK CR database dwells. Most memorial trees occur in line formations and in the category of tree group (29.8 %). The category of solitaires includes 13.47 % of memorial trees, and only 0.74 % of memorial trees occur within a forest stand.

Growth characteristics of memorial trees

The ascertained and evaluated data on memorial trees in the Czech Republic are compared in the following chapter with other available sources dealing with monumental and memorial trees in our territory.

An extensive group of publications on monumental and memorial trees we used to compare with the AOPK CR database consists of manuals dealing with the memorial trees at a regional level (Modrý, 2004; Kubačka & Kubáčková, 2005; Hrubá & Valentová, 2005; Hrušková, 2008; Gergel *et al.*, 2004; Koutník, 1997; Donecová & Janočko, 2003; Michálek, 2008; 2006; Dundychová, 1994; Tábor *et al.*, 2005; Taraba & Navrátilová, 2005; Kovařík *et al.*, 1996). A majority of trees mentioned in these publications do not surpass by their growth the most monumental representatives of the species included in the AOPK CR database. These manuals usually build on the AOPK CR database, and only very exceptionally mention other trees important for a specific region or district, which may overreach the size of memorial trees from the AOPK CR database. For example, in the region of Ústí nad Labem, an individual of elm (*Ulmus* sp.) allegedly occurs according to Vykouk & Keller (2009), which is larger than the elm tree included in the database from 2006, with a girth of 456 cm. In the Olomouc region, a European white elm (*Ulmus leavis*) was recently found with a girth of 660 cm, which would indicate that it is a new largest representative of the species in our country (Olomouc, 2006). These exceptions show that new giant trees can still be found.

The most abundant species of memorial trees are oaks (*Quercus robur*, 15 %) and limes (*Tilia cordata*, 34 %, *Tilia platyphyllos*, 7 %) (Tábor, 1998; 2001; 2002; 2003; 2004; 2005; Kyzlík, 2009; Kender *et al.*, 2005). A similar species composition of memorial trees was mentioned already by Chadt (1913), who mentions 115 lime trees and 56 oaks in his book.

According to the AOPK CR database of memorial trees, the most monumental trees are two large-leaved lindens (*Tilia platyphyllos*) – the so-called Vejdova linden at Pastviny with a girth of 12,25 m and the Sudslavická linden with a girth of 11,50 cm. Other giant trees are represented by the Tatrovická linden (*Tilia cordata*) with 11,22 m near Tatrovice in the Sokolov district, and Žižka's oak (*Quercus robur*) with 10,03 m in Náměšť nad Oslavou (Tábor *et al.*, 1998; 2001; 2002; 2003; 2004; 2005; Kyzlík, 2009; Kender *et al.*, 2005). Chadt

(1913) informs that the most monumental tree at his time was a black poplar (*Populus nigra*) with a girth of 15,71 m (in Lochovice) and lindens (*Tilia* sp.) with girths 14 m or 12,56 m. According to Chadt (1913), the most monumental of oaks was a sessile oak (*Quercus petraea*) with a girth of 12,30 m. Worth mentioning is also the girth of white poplar (*Populus alba*) reaching 9,73 m. According to Heike (1984, 1985), we can find monumental trees also in castle parks and palace gardens; however, they are smaller as compared with the AOPK CR database of memorial trees.

The age of memorial trees is often overestimated, especially in the mentioned oldest specimens (Hartesveldt *et al.*, 1975; Kyzlík, 2009). The AOPK CR database of memorial trees claims that the age of several oldest specimens is assumed over a thousand years. These include three individuals of pedunculate oak (*Quercus robur*) – Körner's oak at Dalovice, Oldřich's oak in Peruce and Žižka's oak near Třebíč, two individuals of large-leaved linden (*Tilia platyphyllos*) – the Klokočovská linden near Klokočov, the Vlášnická (Holub's) linden near the village of Jistebnice, and a common yew (*Taxus baccata*), also called Tisíciletý (Thousand-year old) yew in Žilina near Nový Jičín. The actual age cannot be verified due to its poor health condition and rotten centre of the trunk and this is why the authors differ in the data. Chadt (1913) informs that the oldest trees in the Lands of the Bohemian Crown were yews (*Taxus baccata*), namely a yew at Macocha, the age of which was according to the annual rings 2,000 years, and a still living yew near Pernštejn, which is allegedly up to 2,000 years old. However, Chadt (1913) identifies with the view that oaks and lindens are species that can live up to 1,000 – 1,500 years, according to tree age verified by summing up annual rings or from historical books or chronicles.

There is no doubt that all massive important trees have not been found yet in our territory and a possibility still exists of striking interesting specimens during terrain reconnaissance. An illustrative example of this can be the private tally of significant trees in the Blansko district made by Kala (2007), in which the author mentions monumental specimens of e.g. European hornbeam (*Carpinus betulus*, 340 cm) or Weymouth pine (*Pinus strobus*, 424 cm), with dimensions exceeding those of individuals in the AOPK CR database of memorial trees. Results of inventory in the territory of Soutok show, too, that trees larger than those so far registered in the AOPK CR database can still be found, which is for example documented by a field maple (*Acer campestre*, 504 cm) (Maděra *et al.*, 2006; 2008).

In 2003 – 2004, Lesy České republiky (Forests of the Czech Republic), s.p. (LČR) carried out mapping of memorial trees in the territory managed by the company. Recorded were 308 individuals and groups of "Important Trees of LČR", which were introduced into the corporate database and designated in the field with uniform information panels. One of the most monumental trees is a small-leaved linden (*Tilia cordata*) with a girth of 1,425 cm. This means that the specimen is the largest one in the Czech Republic. Height data of specimens in the LČR database do not markedly differ from the standard tree height range of the given species (Významné stromy LČR, 2010). Vojenské lesy a statky ČR (Military Forests and Farms of the Czech Republic) – VLS responded in 2005 by creating their own database of important trees occurring in the territory under their management. The VLS database currently includes 428 individuals of 22 species. Recorded values of important VLS trees as a rule do not reach dimensions of the same species in the AOPK CR database. A monumental tree worth mentioning is a small-leaved linden (*Tilia cordata*) with a girth of 853 cm, and species that are up to or slightly surpass individuals from the AOPK CR database are represented by a white willow (*Salix alba*) with 713 cm or a European mountain ash (*Sorbus aucuparia*) with 157 cm (Významné stromy VLS ČR, 2010).

Comparing the achieved growth characteristics of memorial trees with data published in the Czech Republic

To be complete, we compared the highest values of growth characteristics in memorial trees with data in dendrological publications (Červenka & Cigánova, 1989; Böhm, 1985; Fér & Pokorný, 1964; Čabart, 1988; Kavka, 1995; Úradníček & Maděra *et al.*, 2001; Svoboda, 1953 – 1957; Musil & Hamerník, 2007; Hejný & Slavík, 2003).

Results of the comparison showed that in girth parameters, ca. 25 % of memorial trees surpass dimensions commonly given for the species. As a rule, the traditional girth dimensions are by 1.1 – 2.6 times greater. Species most exceeding the average girths quoted in the above publications are sessile oak (*Quercus petraea*) (Hejný & Slavík, 2003) and whitebeam (*Sorbus aria*) (Úradníček & Chmelař, 1995). In addition to the monumental lime trees and pedunculate oaks, another species exceeding its usual girth parameters is black alder (*Alnus glutinosa*), which –according to Úradníček *et al.* (2001) usually reaches 350 cm- has respectable 635 cm in the database. Worth mentioning is also the girth of wild cornel (*Cornus mas*), the girth of which is – instead of usual 150 cm (Úradníček & Maděra *et al.*, 2001) – rare 225 cm in the AOPK CR database of memorial trees.

Representatives of species that are allochthonous in the Czech territory do not markedly exceed their usual girth parameters or such cases are rare. For example, very well doing is Austrian pine (*Pinus nigra*), which has reached 376 cm according to the AOPK CR database of memorial trees instead of 320 cm quoted in the professional publications (Úradníček, & Chmelař, 1995; Úradníček & Maděra *et al.*, 2001). Another example is ginkgo (*Ginkgo biloba*) reaching up to 350-620 cm (Musil & Hamerník, 2007), which should have up to 420 cm in girth according to the database. Well off in our conditions is also silver maple (*Acer saccharinum*), which normally reaches a girth of 350 cm (Hejný & Slavík, 2003) and the database of memorial trees contains an individual with 581 cm. A similar case is that of white mulberry (*Morus alba*) reaching 150 cm (Úradníček & Chmelař, 1995), which has a girth of 286 cm in the database.

As to the tree height, the individuals registered in the AOPK CR database usually do not exceed the values quoted in the professional publications, with no difference to whether the species is autochthonous or allochthonous (Hurych, 1996; Červenka & Cigánova, 1989; Pilát, 1953; Větvička, 1984; Kremer, 1995; Bauer, 1989; Anonymus, 1990; Zelený, 1990; Aas & Riedmiller, 1994; Mikula, 1976; Fér & Pokorný, 1964; Wágner & Ždárský, 1999; Koblížek, 2000; Čabart, 1988; Kavka, 1995; Mikula & Vanke, 1989; Úradníček & Chmelař, 1995; Musil & Hamerník, 2007; Hejný & Slavík, 2003). Exceptions are only oleaster (*Eleagnus angustifolia*), larches (*Larix decidua*, *Larix kaempferi*), black poplar (*Populus nigra*) and common pear (*Pyrus communis*), which surpass the published values by 5-10 m.

Comparing the ascertained data on memorial trees in the Czech Republic with the foreign data

Girth characteristics gauged in memorial trees in the Czech Republic can be for interest compared with available growth data on trees from abroad, e.g. with the list Champion Trees of British Islands (Mitchell *et al.*, 1990), list of the oldest German trees (Ullrich *et al.*, 2009), list of trees in Belgian parks (Baudouin, 1992), list of notable trees of France (Cousseran & Feterman, 2009), list of Natural monuments of Poland (Drzewa pomnikowe, 1962-1999) or with the list of important trees of Italy (Cagnoni, 2005), U.S.A. (American Forests, 2004) and Slovak Republic (Kollár & Ondrejka, 2008). It is obvious that several representatives from the AOPK CR database can boldly equal the giant trees registered abroad. Individuals surpassing other giants in Europe are maples (*Acer campestre*, 470 cm, *A. platanoides*, 530 cm, *A. pseudoplatanus*, 808 cm), black alder (*Alnus glutinosa*, 635 cm), narrow-leaved ash

(*Faxinus angustifolia*, 660 cm), white poplar (*Populus alba*, 728 cm), brittle willow (*Salix fragilis*, 545 cm), common pear (*Pyrus communis*, 435 cm), mahaleb cherry (*Prunus mahaleb*, 360 cm) and elms (*Ulmus glabra*, 708 cm and *Ulmus minor*, 641 cm). The largest girth of all conifers is that of Norway spruce (*Picea abies*, 520 cm). Another tree species occurring at the upper limit of tree dimensions is black poplar (*Populus nigra*, 800 cm), which loses only 25 cm on the largest poplar from Italy.

According to the Guinness Book of Records, one of the most monumental trees in Europe is a sweet chestnut (*Castanea sativa*) in Sicily with a girth of 57.9 m and height 21 m. The individual consists of three parts and its largest part has a girth of respectable 22 m. Its name "Chestnut for one hundred horses" is derived from a 16th century legend. Furthermore, the most monumental representative of large-leaved linden (*Tilia platyphyllos*) occurs in Germany, with an unbelievable girth of 1,720 cm (Ullrich *et al.*, 2009), which is followed by a pedunculate oak (*Quercus robur*) with a girth of about 1,400 cm in Sweden (Pakenham, 2003) and a sessile oak (*Quercus petraea*) with 1,260 cm in England (Mitchell *et al.*, 1990). Only several centimetres less has a large-leaved linden (*Tilia platyphyllos*, 1,252 cm) in the Czech Republic. Other monumental specimens occur again in England – a sweet chestnut (*Castanea sativa*) with a girth of 1,180 cm (Mitchell *et al.*, 1990), and in Germany – a pedunculate oak (*Quercus robur*) with a girth of 1,178 cm and a northern red oak (*Quercus rubra*) with 1,125 cm (Ullrich *et al.*, 2009). Remaining individuals surpassing 10 m in girth are represented by a small-leaved linden (*Tilia cordata*) from the AOPK CR Czech database of memorial trees with a girth of 1,122 cm and a common yew (*Taxus baccata*) with a girth of 1,073 cm from England.

According to Chadt (1913), the most monumental individuals in Europe were in the past a common yew (*Taxus baccata*) in England with a girth of 1,800 cm, an elm (*Ulmus sp.*) with a girth of 1,668 cm in Switzerland, a large-leaved linden (*Tilia platyphyllos*) with a girth over 1,600 cm in Bavaria, and oaks (*Quercus sp.*) with girths 1,486 cm and 1,340 cm in England. Chadt (1913) also claims that at that time, the most monumental specimen in our country was a black poplar (*Populus nigra*, 1,571 cm) and informs that already at that time, many other most monumental trees in central Europe occurred in the Lands of the Bohemian Crown. These included the most monumental sessile oak (*Quercus petraea*) with a girth of 1,230 cm, a large-leaved linden (*Tilia platyphyllos*, 1,400 cm) and a small-leaved linden (*Tilia cordata*, 1,100 cm) or a white poplar (*Populus alba*, 973 cm).

The following table (Tab. 7) presents aggregative basic data on the most monumental and oldest individuals in European countries obtained from available sources. Dominating species are once again the representatives of pedunculate oak (*Quercus robur*) and large-leaved linden (*Tilia platyphyllos*).

Table 7: The most monumental and oldest trees in Europe

STATE	the oldest tree		the largest tree	
	species	age	species	girt/cm
England	<i>Quercus petraea</i>	1100	<i>Quercus robur</i>	1316
Germany	<i>Quercus robur</i>	850	<i>Tilia platyphyllos</i>	1720
Czech republic	<i>Quercus robur</i>	1000	<i>Tilia platyphyllos</i>	1252
Netherlands	<i>Quercus robur</i>	1000	<i>Quercus robur</i>	1000
Belgium	*	*	<i>Quercus robur</i>	995
Poland	*	*	<i>Quercus robur</i>	992
Spain	<i>Pinus canariensis</i>	1000	<i>Eucalyptus globulus</i>	1375
France	*	*	<i>Sequoiadendron giganteum</i>	1260
Slovakia	<i>Tilia platyphyllos</i>	700	<i>Tilia platyphyllos</i>	1100
Italy	<i>Olea europea</i>	3800	<i>Castanea sativa</i>	2200

In the AOPK CR database of memorial trees, the age of several specimens is assumed up to a thousand years, especially if the data have been taken over from various legends and chronicles (Hrušková & Turek, 1986; 1995; 1999; 2001; 2005). In central Europe, old trees usually reach an age of 300-600 years (Hejný & Slavík, 2003; Úradníček *et al.*, 2001; Kavka, 1995), although some individuals are supposed to be up to a thousand years old (Kavka, 1995; Mikula & Vanke, 1989). The hitherto published available data about the maximum age of individual tree species have been aggregated for interest only (Větvička, 1984; Mikula, 1976; Fér & Pokorný, 1964; Čabart, 1988; Kavka, 1995; Mikula & Vanke, 1989; Úradníček & Chmelař, 1995; Úradníček & Maděra *et al.*, 2001; Svoboda, 1953–1957; Musil & Hamerník, 2007; Hejný & Slavík, 2003). The available data on the age of memorial trees, which are usually based on the estimate of surveyors, correspond to the published values. The only exception is a European ash (*Fraxinus excelsior*) aged 400 years, which can reach only 200–250 years according to Kavka (1995), Čabart (1988), or a black poplar (*Populus nigra*) whose age is allegedly 400 years although it can normally reach only 200 years (Kavka, 1995; Čabart, 1988). Worth mentioning is also the registration of up to 300-year old wild service trees (*Sorbus torminalis*) and service trees (*Sorbus domestica*) although their individuals usually reach only a half of the age (Kavka, 1995; Mikula & Vanke, 1989).

Data on the most monumental individuals contained in the LČR and VLS databases are based on estimates (Významné stromy VLS ČR, 2010; Významné stromy LČR, 2010). Nevertheless, the age of newly entered individuals is recorded according to stock maps and registration sheets, which represent creditable guidelines to determine the age of other trees in the future.

Unfortunately, the data from European databases are not complete either, and therefore cannot be objectively evaluated. According to a research study conducted at the University in Ulmea, the oldest tree in Europe was determined a Norway spruce (*Picea abies*) in Sweden, for which the age of roots was determined to be 9,550 years. Since it is a clone, the age of its trunk is estimated at 600 years (Kullman, 2008). The other oldest European species are representatives of common yew (*Taxus baccata*), for which it was demonstrated that they can live up to 4,000 years in England (Billing, 2004) or Bosnian pine (*Pinus leucodermis*, 1,270 years – Italy, 1,300 years - Bulgaria) and European larch (*Larix decidua*) with 2,085 years (Pakenham, 2003). Tree species that may rank with the oldest ones are common fig (*Ficus sp.* – Spain), chestnut (*Castanea sativa*, 3,000 years - Italy), olive trees (*Olea europea*, 3,000 let

– Italy, 2,800 years – Portugal) or pears (*Pyrus communis*) since they represent trees humans have been using for their own benefit for over 2,000 years (Noris, 2011).

The oldest clone in the world is mentioned to be a quaking aspen (*Populus tremuloides*, so-called Pando), which is 80,000 -1 million years old. It is at the same time considered one of the heaviest organisms in the world (6,000 tons) (Mitton & Grant, 1996). Until recently, the oldest tree in the world was considered a bristlecone pine (*Pinus longaeva*, so-called Prometheus) with an age estimated at 4,862 years; unfortunately, it was felled by accident in 1964. Its place has been taken by another bristlecone pine (*Pinus longaeva*, so-called Methuselah), the age of which was set for 4,842 years. The two individuals were to be or may be seen in California, U.S.A. (Rocky Mountain Tree-Ring Research, 2011).

ASSESSMENT ACCORDING TO THE BIOGEOGRAPHICAL POINT OF VIEW

Most decreed memorial trees fall in the Beech altitudinal vegetation zone (18.2 %). A great part of them can be found also in the Oak-Beech (17.2 %) and Fir-Beech (12.5 %) altitudinal vegetation zones. This representation of memorial trees in altitudinal vegetation zones copies the AVZ representation in the Czech territory. Apparent is a positive dependence between the representation of memorial trees and the population density in the individual altitudinal vegetation zones (Tab. 8).

Table 8: Representation of altitudinal vegetation zones in the Czech Republic (according to Buček & Lacina, 2002)

Altitudinal Vegetation Zone (Zlatník, 1978)	representation in the CZ (%)	fertile ground	forests	grasslands	orchards and gardens	vineyard	occupancy
							(population/ km ²)
1. Oak V.Z.	3	62	13	2,7	4	4	130
2. Beech-oak V.Z.	12	61	14	3	4	0.5	290
3. Oak-beech V.Z.	18	50	25.7	7.1	3.7	*	157
4. Beech V.Z.	36	42	33	12	2.4	*	92
5. Fir-beech V.Z.	22	25	48.6	15.4	1.4	*	58
6. Spruce-fir-beech V.Z.	2.9	1	74	12	*	*	19
7. Spruce V.Z.	0.9	*	1.69	*	*	*	*
8. Dwarf Pine V.Z.	0.1	*	0.29	*	*	*	*
9. Alpine V.Z.	*	*	*	*	*	*	*

Having compared the occurrence of memorial trees in the altitudinal vegetation zones with data about altitudinal vegetation zones of the natural occurrence of given species in the Czech Republic (Úradníček & Maděra *et. al.*, 2009), we can state that 63 % of memorial trees occur beyond their natural occurrence in the AVZ of the concerned species.

Usually the trees occur higher by 1 – 2 AVZs. Only in three specimens of memorial trees, we recorded their occurrence in lower altitudinal vegetation zones. For example, a memorial Norway spruce (*Picea abies*) is recorded as low as in the Oak altitudinal vegetation zone. Of broadleaved tree species, for example, elm tree (*Ulmus minor*), which is considered a thermophilic species occurring up to the Oak-Beech altitudinal vegetation zone, occurs according to the AOPK CR database as high as in the Beech and even in the Oak-Coniferous altitudinal vegetation zones. Deviation from its natural site can be seen also in a memorial

individual of European hornbeam (*Carpinus betulus*), which occurs in the Beech AVZ although its natural occurrence is to be the Oak-Beech AVZ.

The above discrepancies in the occurrence of some tree species as compared with their natural range of occurrence, expressed by the biogeocoenological formula, can be assigned to the chosen basic unit – cadastral area, based on which the data on the altitudinal vegetation zones were combined with the database of Biogeographical Registry. Important is also the human factor and the fact that some species were planted outside their natural sites.

The most abundant species is small-leaved linden (*Tilia cordata*), which occurs from the Oak to the Fir-Beech altitudinal vegetation zones. Much lower representation has pedunculate oak (*Quercus robur*) occurring in 5 coding units and large-leaved linden (*Tilia platyphyllos*) occurring in 3 coding units.

Having compared the data on altitudes at which the memorial trees occur with the data in professional publications, we can state that most memorial trees grow within the natural range of their occurrence. Only black poplar (*Populus nigra*) and pedunculate oak (*Quercus robur*) were recorded at higher elevations. Black poplar (*Populus nigra*) was found as high as at 760 m above sea level while the documented highest altitude of its occurrence (Čabart, 1988) was 600 m a.s.l. According to the data, pedunculate oak (*Quercus robur*) occurs as high as at 905 m a.s.l. Up to the present, the highest altitude at which it was recorded was 800 m a.s.l. (Hejný & Slavík, 2003). Two species, representatives of memorial trees, i.e. small-leaved linden (*Tilia cordata*) and European white elm (*Ulmus laevis*) occur on the boundary of their natural range, too. The elm reaches even slightly beyond the boundary (498 m a.s.l.) because the highest growing elm is documented from 420 m a.s.l. (Hejný & Slavík, 2003). Of conifers, the usual elevation was considerably exceeded by European larch (*Larix decidua*), in which Musil & Hamerník (2007) state the greatest occurrence in the Czech Republic at 750 m a.s.l., while the memorial individual grows at 1,015 m a.s.l.

Regarding the altitudes, the data could be compared also in the LČR and VLS databases of important trees. According to the LČR, the occurrence of important trees corresponds with the traditional occurrence of native species. In specimens chosen by VLS as significant trees, a number of species grow beyond their usual altitudes. This particularly applies, similarly as in the AOPK CR database of memorial trees, to black poplar (*Populus nigra*) and pedunculate oak (*Quercus robur*). VLS surveyors found a black poplar (*Populus nigra*) at 730 m a.s.l. and a pedunculate oak (*Quercus robur*) at 900 m a.s.l., which documents that the occurrence of tree species proclaimed as memorial trees at higher altitudes is not a coincidence and the species can be found growing actually higher than claimed by available publications (Hejný & Slavík, 2003; Čabart, 1988). Apart from the above mentioned species, the VLS database contains also European apple (*Malus sylvestris*), small-leaved linden (*Tilia cordata*) and wild service tree (*Sorbus torminalis*) growing at higher than usual elevations.

One of partial benefits of this study is evaluation of the occurrence and abundance of memorial trees in units of biogeographical division of the Czech Republic (Culek *et. al.*, 1996) and further extension of the characteristics of bioregions (Map Appendices Nos. 4, 5).

CONCLUSION

Important trees can be considered trees that reach high age, unusual size or represent an important part of cultural and historical heritage. We learn about the existence of these important trees either from local people or thanks to inventories focused on such trees (Maděra *et. al.*, 2000; Brzobohatý, 2000; Sedláčková, 2007; Rychtecká, 2004; Dreslerová, 2006; a.o.). The most popular and available at a national level is considered the database of memorial trees of the Czech Republic, which is a part of the Central List of Nature

Conservation (AOPK CR) and which was provided for a detailed analysis. Based on a combination with another extensive database of Biogeographical Registry, a comprehensive overview was compiled about the current state of memorial trees in relation to biogeographical units (abundance, species composition and maximum growth characteristics). Occurrence of monumental trees and knowledge of the growth parameters of individual species should constitute a part of basic landscape and species characteristics to figure out what maximum growth dimensions the given species can reach in the given site conditions. One of outstanding contributions of this study is the evaluation of the occurrence and abundance of memorial trees according to biogeographical division of the Czech Republic (Culek *et. al.*, 1996) and addition of further data to the characteristics of bioregions.

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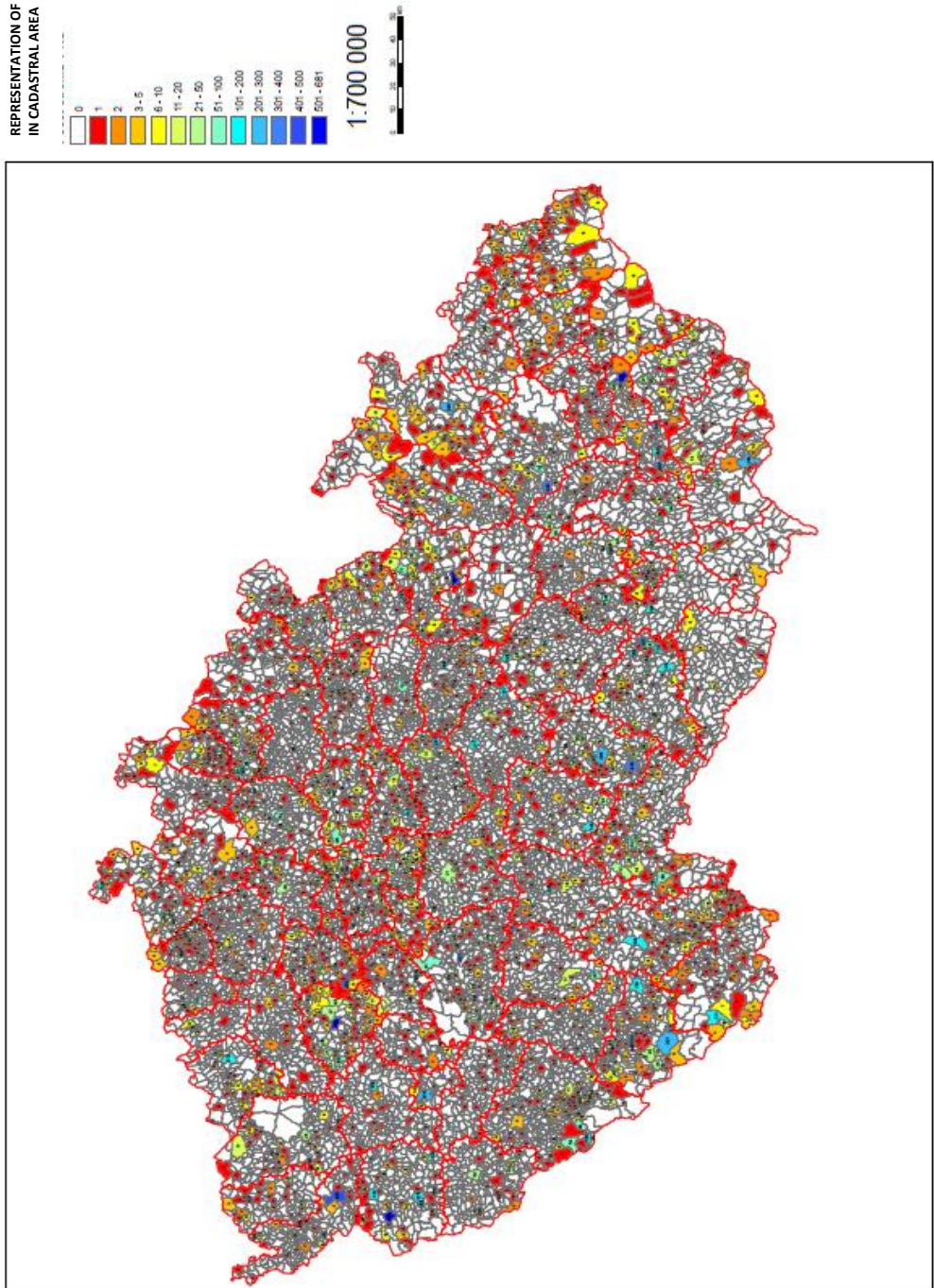
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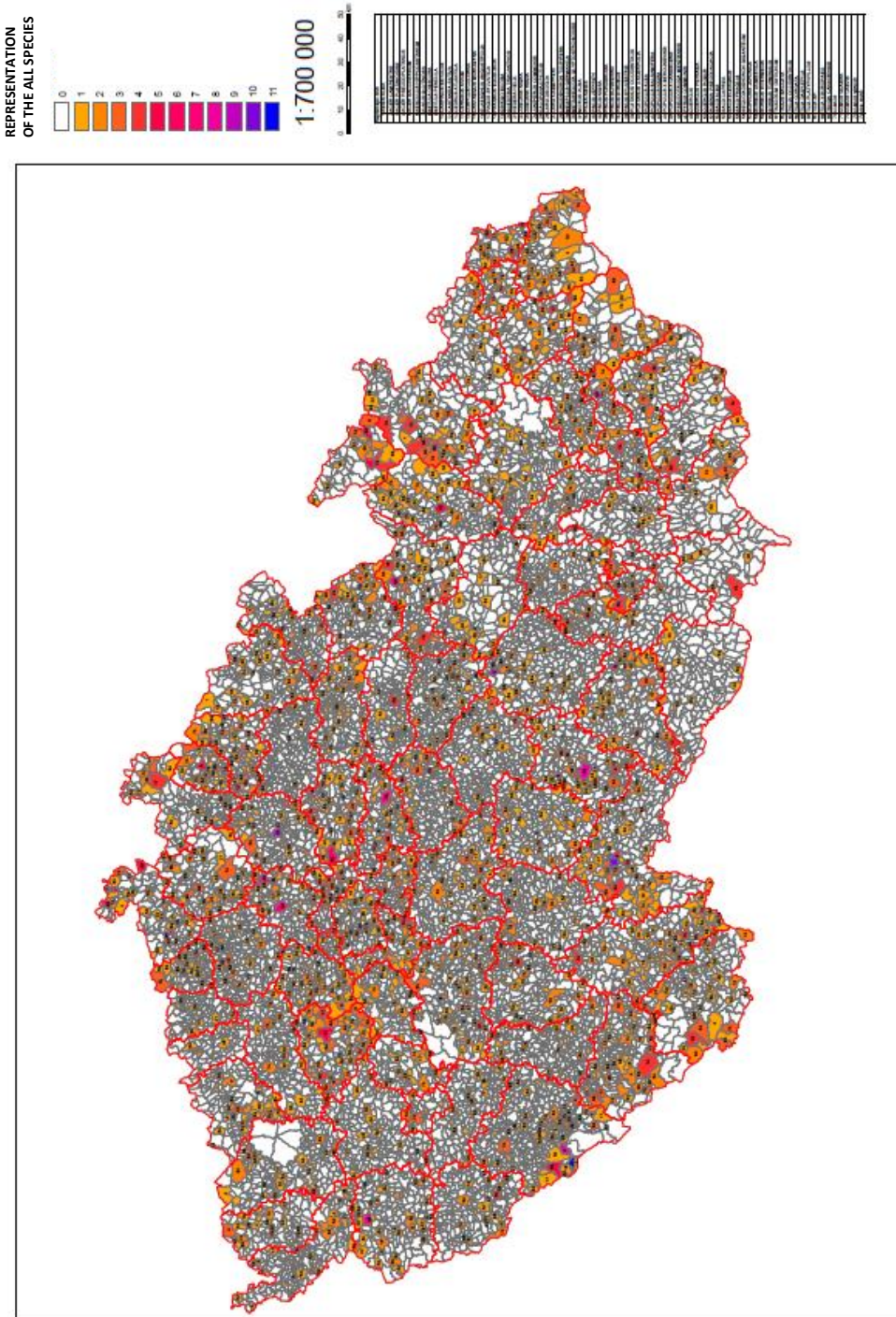
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APPENDIX

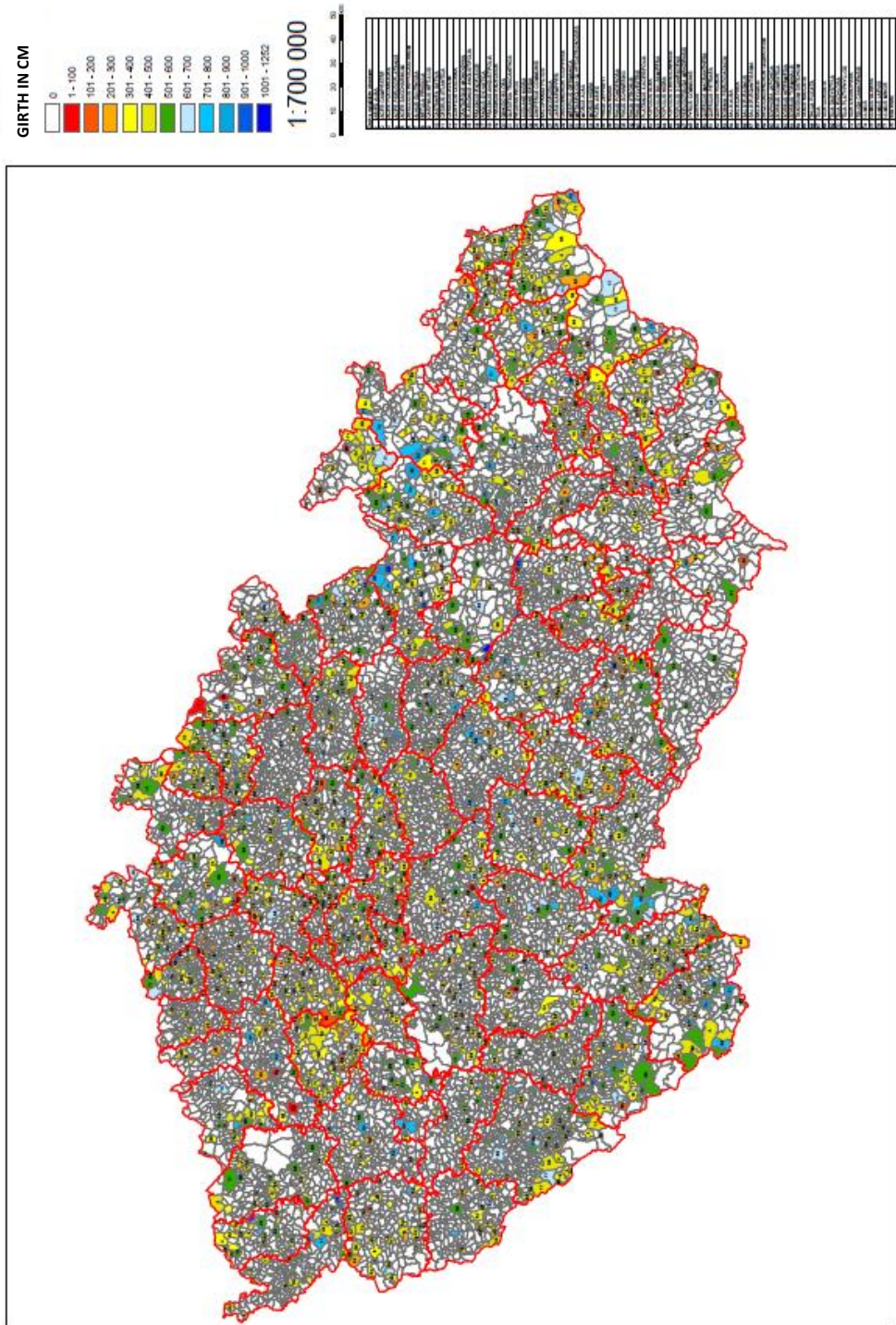
Map. 1: Representation of memorial trees in the Czech Republic in cadastral area



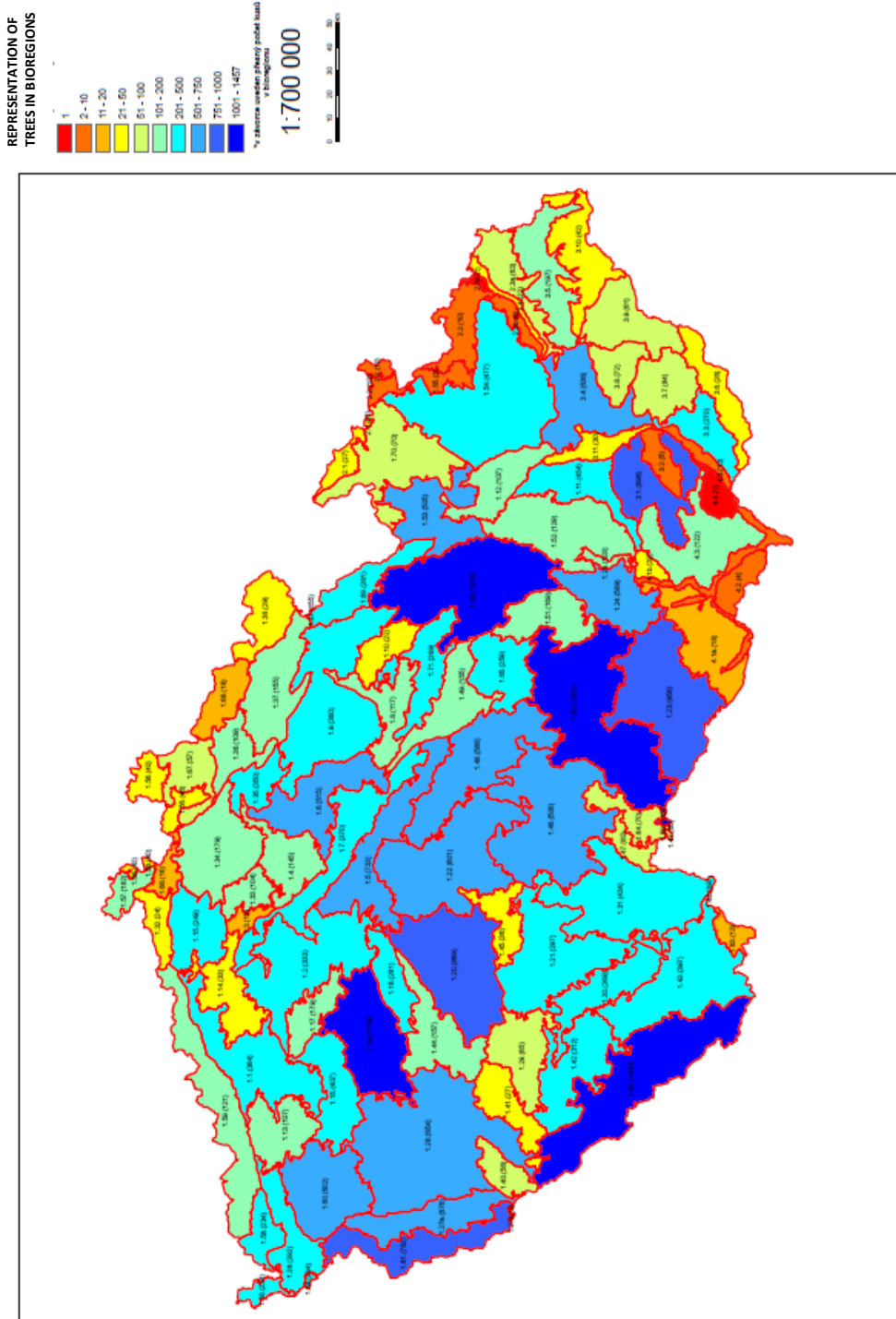
Map. 2: Representation of species of memorial trees in the Czech Republic in cadastral area



Map. 3: The largest girth of a memorial tree in the Czech Republic in cadastral area



Map. 4: Representation of memorial trees in bioregions in the Czech Republic



Map. 5: Representation of memorial trees in bioregions in the Czech Republic

