

In search of the last remaining giants. Modelling the conservation potential of century old trees within the Continental and Steppic Biogeographical Regions of Romania.

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Received on <05-03-2019>, reviewed on <30-04-2019>, accepted on <02-05-2019>

Abstract

The present paper aims to model the potential for conservation of some very large specimens of either indigenous or human introduced tree species located within the Continental and Steppic Biogeographical Regions of Romania, areas characterized by considerable natural diversity. Centuries of human intervention have resulted in the major replacement of the natural vegetation with semi natural forests in the highlands, pastures and permanent crops at the hills and arable land in the lower areas. The once pristine landscapes present numerous remains in the form of old trees, while other exotic introduced species are common. In order to assess their conservation potential, we applied an encyclopedically approach centered on numerous field observations, measurements, scientific literature research, historical maps analyses and discussions with locals. The results certify the existence of different species characterized by a medium and high potential for conservation. Some of them are the subject of numerous researches and possess favorable conservation status while many are poorly or virtually unstudied and not protected. Such findings are usable in complex domains, mainly biodiversity conservation, durable ecosystem management and ecotourism.

Keywords: *remarkable trees, conservation potential, conservation status, Continental Bioregion, Steppic Bioregion*

Rezumat. În căutarea ultimilor giganți. Modelarea potențialului de conservare al arborilor seculari din Regiunile Biogeografice Continentale și Stepice ale României.

Articolul de față urmărește modelarea potențialului de conservare al câtorva specimene foarte mari de arbori aparținând unor specii atât autohtone cât și exotice din Regiunile Biogeografice Continentale și Stepice ale României, areale caracterizate de o mare diversitate a mediului natural. Secole de intervenție antropică au generat înlocuirea majoră a vegetației inițiale cu păduri seminaturale în zone de munte, pășuni și culturi permanente la deal sau terenuri arabile la câmpie. Peisajele inițial virgine prezintă numeroase rămășițe prin prisma arborilor bătrâni, în timp ce alte speciile exotice sunt comune. În vederea identificării potențialului de conservare a acestora, a fost aplicată o abordare enciclopedică axată pe numeroase deplasări în teren, măsurători, cercetări în literatura de specialitate, analiză de hărți istorice și discuții cu localnicii. Rezultatele certifică existența a diferite specii caracterizate de un potențial de conservare mediu și ridicat. Câteva dintre aceste specimene sunt subiectul a numeroase cercetări și posedă un statut de conservare favorabil, în timp ce numeroase altele sunt practic necunoscute și neprotejate. Rezultatele sunt utile în domenii complexe precum conservarea biodiversității, managementul durabil al ecosistemelor și ecoturism.

Cuvinte-cheie: *arbori remarcabili, potențial de conservare, statut de protecție, Bioregiunea Continentală, Bioregiunea Stepică*

Introduction

Remarkable trees represent some of the largest, rarest and most spectacular life forms. A remarkable tree is defined as a specimen characterized by: a) a quantitative aspect represented by an unusual size or age, which exceeds the species' normal thresholds and b) a qualitative one, centered on the specimen's ability of offering complex ecosystem services for both humans and animal communities (Hartel & Tamas 2015). Other common approaches concerning the subject include secular, several centuries old, exceptional or even veteran tree (Vasile et al. 2013). Due to their ability of growing for such long periods of times and consequently reaching considerable sizes, large trees possess complex ecological, physical, scientific, economic,

historical or cultural values, usable for both wildlife and humans (Radu & Coandă 2005). Large and old specimens offer important economic resources for rural populations, maintain suitable habitats for a wide range of animal or plant species and could expose valuable scientific information concerning primeval landscapes or archaic cultures, traditions and beliefs (Hartel & Moga 2010). Some specimens enhance the cultural and historical identity of traditional communities or celebrate notable historical events or actions (Hartel et al. 2015). Others possess a powerful sacral identity, being perceived by locals as holy elements. Based on their remarkable physical particularities and mythological aura, some specimens portrait mystical images regarding frightening creatures and demonical characters or by opposite, heroes or guardians of

significant places and legendary objects (Kingsbury 2015). The sum of all these values composes the trees' conservation potential, which differs considerably between specimens based on the selected criteria for analysis.

The trees' conservation potential usually represents the main trigger regarding their conservation status. Therefore, a tree conservation or protection status is composed of: a) the specimens' conservation potential discussed above and b) the economic, administrative and legislative will regarding the local actors legally capable of deciding and assessing that status (Bolea et al. 2011). Old trees are conserved and therefore protected as both individual elements stated as natural monuments or as integrated elements of larger and more complex landscapes, such as primeval forests, secular ones or medieval wooden pastures, which benefit by a favorable status due to Natura 2000 sites, national or natural parks or scientific reserves.

Remarkable trees are characterized by a complex geographical distribution, spreading from the tropics to temperate regions. Within the tropical areas, the African baobabs, oriental planes of the Mediterranean regions, kauri trees of New Zealand or camphor trees of Easter Asia reach some of the largest ages and girths (Kingsbury 2015). Some exemplars, as the famous sequoias of North America, are the largest living life forms in the history of the natural world, reaching heights of almost 100 meters and ages exceeding 2000 years. Europe stands out by conserving the largest and oldest oaks, poplars or benches within the world. Therefore, the oak with the largest girth measured in modern times is located in Norra Kvill, Sweden and named Kvilleken. It was registered as having 14.75 meters girth at a height of 130 cm above ground level (Pătruț 2011). Also, the great oak located within the zoological garden of Ivenack, Germany, possesses a volume of 180 m³, a total height of 35.5 m and a girth of 11.35 m, therefore being the largest oak by volume ever estimated (Pătruț 2011). In Romania, at the outskirts of Răfăiță village stood intact until 1997 the world's thickest grey poplar, associated with Stefan the Great and having a girth of 14.1 m at its peak while at Mocod, Bistrița-Năsăud, a black poplar possessed at its prime a girth of 12 meters (Pătruț et al. 2012). Nevertheless, according to Pătruț, some of the oldest oaks ever analyzed are located within Romania, namely the oaks of Cajvana and Tebea, both exceeding 800 years (Patrut et al. 2010, Pătruț et al. 2011).

All of these exceptional trees of Romania, some of them being the oldest and largest of Europe, are

located within the vast Continental Biogeographical Region (BCR) or in the Steppic Biogeographical Region (BSR) and represent a solid statement concerning the regions potential respect to this subject. Romania encompasses five Bioregions, more than any European country besides Russia. These are the Continental, Alpine, Pannonic, Steppic and Pontic Bioregions (EEA 2016) (Figure 1). The BCR occupies the largest part of the country, entirely enclosing as a giant arch the Alpine Bioregion. It neighbors in the east the Steppic Bioregion and the west the Pannonic one. It spreads mainly over plains, plateaus, hill areas and low mountains, being by far the most diverse and biogeographically complex within the five bioregions. The BCR extends over two latitudinal vegetation belts, namely the southern sylvosteppes and the nemoral deciduous xerothermal forests of the higher plains (Călinescu 1969). It also encompasses two vegetation altitudinal levels, such as the durmast mixed oak forests, disposed within the humid central plains of Muntenia and the hill oak and bench mixed forest spread in the higher hills and lower mountains. Finally, there is the azonal floodplain vegetation composed by poplar and willow forests growing within the occasionally flooded internal river meadows (Geacu et al. 2018). The BSR was occupied by immense swamps and flooded forest especially in the Danube meadows, while the higher plateaus of Dobrudja were the domain of vast sylvosteppes and steppes (Geacu et al. 2018). Despite its complex natural potential, the BCR is characterized by an aggressive human impact, dating back over hundreds of years. Consequently, the once huge lowland durmast and dry oak forests were massively cut off and replaced with arable crops starting with the 1829 Treaty of Adrianople while the hill forests were converted into vineyards, plantations or pastures (Ioja 2000, Muică & Dumitrașcu 2001, Dumitrașcu 2007, Grigorescu 2010, Niculae 2012, Vijulie 2010). The only potential virgin areas are represented by the isolated bench forest protected in the Carașului Key National Park in the Banatului Mountains (Khorn et al. 2012). Nevertheless, the BCR suffered undergone the human introduction of numerous exotic phytogeographical elements, such as the oriental plane and chestnut tree from the Mediterranean regions or the mulberry tree and Japanese acacia of Eastern Asia (Dumitrașcu & Ines 2016). Concerning the BSR, starting with 1950 all of the regions primeval natural habitats were converted into arable land, present day remains of pure wilderness being extremely scarce (Pașcovski & Doniță 1967).

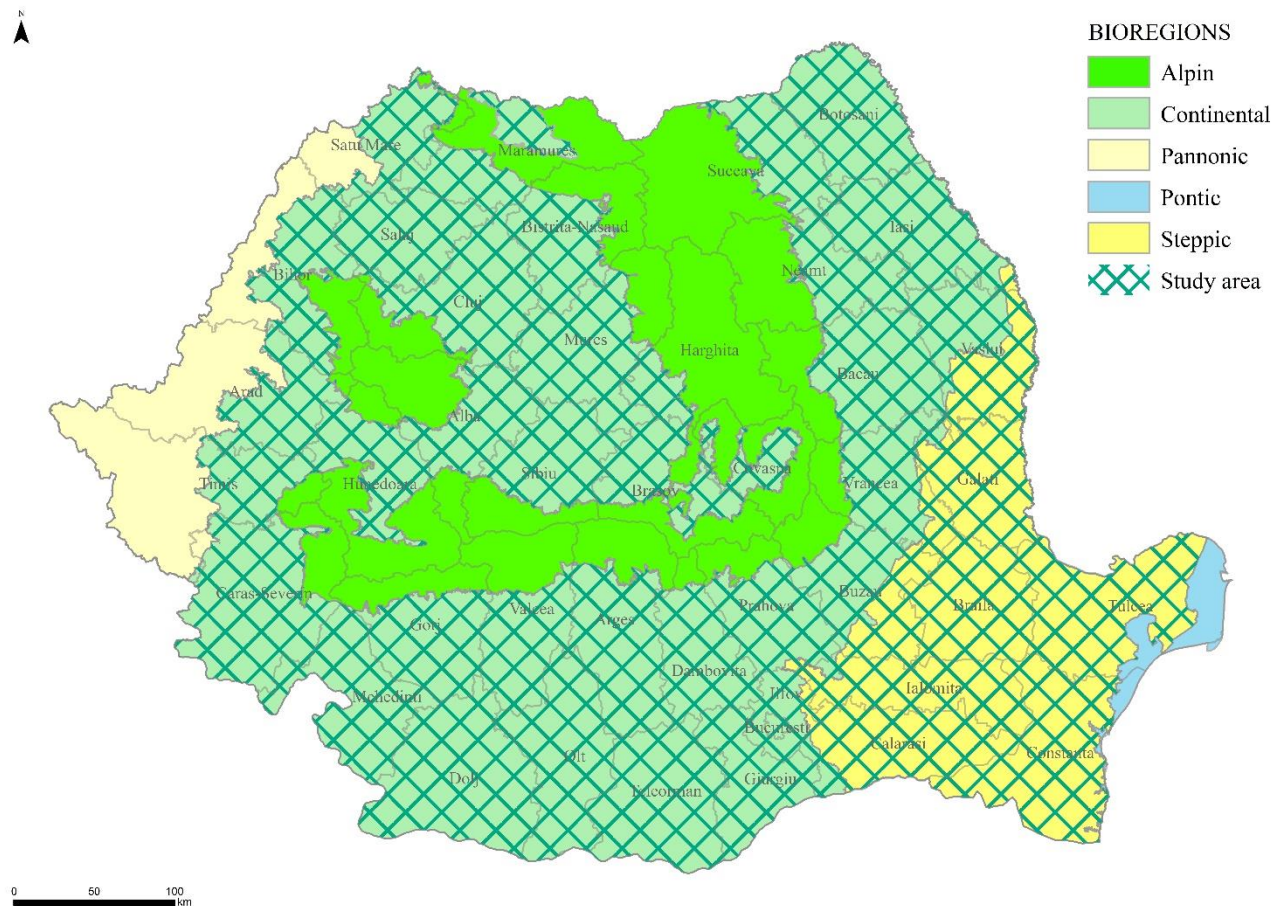


Fig. 1: The location of the study area (Source: EEA 2016)

The importance of protecting remarkable trees is crucial in order to favor the access of both people and animals to numerous ecosystem services and resources. Nevertheless, their conservation is beneficial in different modern research domains, namely conservation biogeography, biodiversity protection, landscape ecology, sustainable landscape planning, agro-forestry, agriculture, modelling species distributions, ecotourism, social and cultural studies, historical geography and toponymy, research regarding human impact over natural ecosystems, analyses concerning land cover and land use dynamics or phyto and zoological elements response to climate change (Radu & Coandă 2005, Bolea et al. 2011, Vasile & Scărlătescu 2013, Vasile et al. 2013, Bolea 2013, Hartel et al. 2015).

Other studies related to our research theme comprise assessments centered on carbon dating very old oaks, poplars or ashes (Pătruț et al. 2010, Pătruț 2011, Pătruț et al. 2011, Pătruț et al. 2012, Patruț et al. 2018), encyclopedically approaches concerning information regarding exceptional specimens (Bolea & Vasile 2011, Vasile & Peter 2011, Bolea & Ienășoiu 2011, Constandache et al. 2012, Bolea et al. 2012, Bolea et al. 2013) and even theoretical papers seeking to highlight the

importance of protecting remarkable trees (Radu & Coandă 2005). Furthermore, numerous investigations are developed over the goal to document the human influence over natural environment elements, especially lowland forests within urbanized and agricultural areas (Grigorescu & Geacu 2017). Finally, several evaluations which highlight the biological characteristics of very old virgin or quasi-virgin forest (Giurgiu et al. 2001, Veen et al. 2010, Khorn et al. 2013).

Based on the stated aspects, we have formulated the next research topics: the BCR and BSR are characterized by the presence of diverse high conservation potential remarkable trees that are poorly studied and by consequence possess an unfavorable conservation status. The research question supporting the study is: are there remarkable trees within the BCR and BSR encompassing both a high conservation potential and complementary an unfavorable protection status? The aim of the study is represented by the conceiving of a diagnosis in order to highlight the existence of high conservation potential remarkable trees within the BCR, which are not valued. The two objectives of the research are: O1) to identify the spatial distribution of various representative

remarkable trees within the BCR or BSR and O2) to analyze their conservation potential and protection status in respect to establish major vulnerabilities and potential hotspots.

Method

In order to conduct O1, we have performed analyses of scientific literature and oral information, conducted field observations and validations and developed a map consisting in the distribution of remarkable trees number per TAU, representing Result 1. Also, for assessing O2 we have conceived a selection of criteria usable for identifying various potential types of values proper to be attributed to remarkable trees. The trees were filtered according to the selected set of criteria. Consequently, Result 2 is represented by a table encompassing the conservation potential and protection status for every specific individual.

The first step consists of the investigation of a rich pallet of sources, both written and oral, in order to select our potential candidates as remarkable trees. Within oral sources, discussions with locals proved the most productive due to their own complex field experiences. Nevertheless, the information contained by old toponyms scattered on historical maps (Specht 1790-1791, Szatmary 1864, Crăciunescu et al. 2011) were consistent. Various web sites engorge a large volume of precious data, particularly the ones dedicated to promote remarkable trees (Hartel & Tamas 2015). The last groups of sources accessed is represented by specialty books and articles, characterized by a high level of credibility due to their scientific background. Major examples include touristic atlases and guides, specialty books regarding the fields of ecology, forestry, nature protection, history and tourism or scientific articles written in order to analyze different monumental trees exceptional age or capability of offering complex services (Giurescu 1976). Furthermore, the trees' location within virgin or quasi-virgin forests, cultural landscapes or protected areas are subjects commonly studied (Giurgiu 2001, Veen et al. 2010). Despite the fact that they lack a scientific background and consequently possess low credibility, the personal descriptions of amatory travelers engorge precious information concerning different monumental trees (Vârzaru 1974).

The second step consists of filed validations that extended over a five years period (2015, 2016, 2017, 2018 and 2019). Field trips were conducted using different methods of travel in every season, each site being analyzed only once. A total of 26 TAUs along with Bucharest Municipality were filtered, located within twelve counties, displayed especially in the central and southern part of Romania. Due to our personal material and temporal

limitations we were unable to develop a uniformly displayed sampling over the entire BCR and BSR, regions as Moldavia being currently outside our reach.

The third step in centered on conducting a cartographical approach in order to express the number of remarkable trees identified per TAU. Prior to this purpose we have accessed spatial vector data consisting in Bioregions, TAU and County limits of Romania (EEA 2016, A.N.C.P.I. 2006). The projection system used is Stereo 70.

We have identified tree major dimensions encompassing a set of six potential values proper to be attributed to remarkable trees which highlight their utility for human and wildlife communities. These are the Phytogeographical, Zoogeographical and Human dimensions and include Taxonomic-ecologic, Physical, Habitat for animals, Historical-cultural-mythical, Scientific and Economic-touristic values (Radu & Coandă 2005, Hartel et al. 2015, Moga et al. 2016). Nevertheless, in order to determine if the sampled trees possess the respective values, we have established several criteria both quantitative and qualitative according to which the specimens were evaluated.

The Phytogeographical dimension reflects the trees utility for plant communities. It encompasses two values, the Taxonomic-Ecologic and the Physical-Aesthetical. The first value is identifiable by several criteria, such as the presence of valuable species (namely rare, endemic, indicative taxa, relict or under protection) (Geacu et al. 2018) and location within or in the proximity of a site characterized by an advanced natural value (such as SCI, SPA, National or Natural parks, Scientific reserves, Potential Virgin or Quasi-virgin forests, forests characterized by a High Conservation Potential, wetlands or monuments of nature) (Pătru-Stupariu et al. 2013). The second corresponds to cases were the following elements occur: presence of remarkable physical characteristics such as an exceptional girth, caves, hillocks, very large branches, advanced level of preservation or intactness, positive anthropic interventions as protective fence, informative panels or plates (Popa 2016).

The Zoogeographic dimension represents the remarkable trees possibility to offer services for various animal species, namely habitats, resources or shelter. It encompasses only one value, the Habitat for animals function, determinable by the next criteria: presence of common animal borrows and nests indicating habitats for a wide range of generalist species and location within or in the proximity of a site characterized by the presence of large carnivores, examples being bears, wolves or lynx (Roelling et al. 2014, Cristescu et al. 2019),

raptor or water birds, reptiles and valuable cinegetic species as wild boar or reindeer (Geacu 2011).

The Human dimension highlights the trees importance for people. It is decomposed into tree values, each of them possessing various identification criteria. The first is the Historical-Cultural-Mythical value, recognizable by the trees significance based on an exceptional age, toponyms, association with historical events, characters, places or other elements, location within or in the proximity of a valuable historical site due to notable concentration of historical monuments or sites included under UNESCO, inclusion in a cultural landscape characterized by the presence of traditional activities, religious significance due to a holy or sacral identity and mythical aura based on popular believes, rituals and legends (Hartel & Moga 2010, Hartel & Tamaş 2015, Hartel et al. 2015, Moga et al. 2016). The second is the Scientific value and it is expressed by the presence of studies and researches materialized through scientific articles, books, research projects, encyclopedias or documentaries. We also included the Economic-Touristic value, which includes several criteria: attractiveness and notoriety based on the presence of infrastructures, thematic trails or popularity within web sites or other online sources, accessibility based on road distance to the nearest village, road altitude variation to nearest village, nearest village distance to rail station, presence of mobile phone signal, location accessibility based on land cover characteristics and propriety regime and location within or in the proximity of a site characterized by the potential to offer natural resources for human activities such as wood or timber.

The proposed aspects are selected based on cross-referencing the available geographical, biological, historical and scientific literature (Geacu et al. 2018). We consider relevant in order to achieve our goal the selected set of dimensions, types of values and complementary criteria due to the fact that they encompass the majority of possible utilities offered by very old and large trees. Based on investigating the specimens correspondence to the selected criteria we could determine the type of value and consequently dimension proper to be assigned to the respective individual. Consequently, if the specimen possesses only one dimension it shall be assessed with a low conservation potential, reflecting usually a unidirectional usable specimen valuable only from one perspective, which can be natural (either by plant or animal communities) or social-economic (by humans). The presence of two dimensions is specific to individuals characterized by a medium potential due to their utility in providing much more complex services while the exemplars assessed as having three dimensions are the ones characterized by a

high or advanced conservation potential, being able to offer numerous benefits for a wide variety of natural and anthropic entities.

Finally, the trees' conservation potential was correlated with their protection status, in order to identify both favorable situations and possible dysfunctions. The protection status was established by intending discussions with local forest men and investigating the information retailed by protected areas management plans, touristic guides, forestry books and scientific articles (Paşcovschi & Doniţă 1976, Giurescu 1976, Brânzan 2013).

Result and discussion

The first result, corresponding to O1 is represented by a map encompassing the number of remarkable trees identified at TAU level (Figure 2). The 68 specimens are disposed within 26 TAU and one municipality as it follows: only one specimen in thirteen TAUs, specifically Băneşti, Bărcăneşti, Bogdana, Botoroaga, Breaza de Jos, Buftea, Cocorăşti-Misli, Fundeni, Mangalia, Răsuceni, Remetea, Sibiu, and Tătărani, two specimens in eight TAUs, namely Ciolpani, Conţeşti, Drăgăneşti-Olt, Drăgăneşti-Vlaşca, Frumuşani, Gruiu, Obârşia, and Ştefăneştii de Jos, three individuals in Toporu, four exemplars in Homorod, Iormeneşti, and Sighişoara, eight trees in Borduşani and sixteen remarkable trees in Bucharest Municipality, by far the largest number recorded. Except Borduşani and Mangalia, which are located in the BSR, all of the other TAUs are disposed in the BCR.

The second result representing the materialization of O2 consists in a table (Table 1) encompassing the 68 specimens analyzed, their conservation potential and their protection status. All the remarkable trees have been coded with numbers from 1 to 68. The order of the trees from the table does not follow a specific criterion. From the total number of specimens, only four have both a high conservation potential and are not protected, being located in TAU Mercheaşa (No. 6, 7, 8) and TAU Iormăneşti (No. 9). By opposite, the five oaks of Sighişoara (No. 1, 2, 3, 4) and Mercheaşa (No. 5), despite expressing a similar potential, possess a negative status. Fourteen tress were assessed as having a medium conservation value and an unfavorable status. These are the ones situated in Iormăneşti (No. 10, 11, 12), Ciolpani (No. 23, 24), Gruiu (No. 25, 26), Fundeni (No. 45), Frumuşani (No. 46, 47), Bujoreni (No. 48), Drăgăneşti – Vlaşca (No. 50, 51), and Obârşia (No. 57). Nevertheless, twenty-one specimens respect the same potential and are protected, namely the ones of Sibiu (No. 13), Remetea (No. 14), Cocorăşti-Misli (No. 15), Tătărani (No. 16), Breaza de Jos (No. 17), Bucharest

(No. 27, 33, 34, 37), Bogdana (No. 55), Obârșia (No. 56), Drăgănești – Olt (No. 58, 59), and Bordușani (No. 61, 62, 63, 64, 65, 66, 67, 68). A low conservation potential was modelled for ten trees that are not protected. These are the specimens from Bănești (No. 18), Bărcănești (No. 21), Buftea (No. 22), Bucharest (No. 38), Ștefănești de Jos (No.

43, 44), Botoroaga (No. 49), and Toporu (No. 52, 53, 54). Finally, fourteen specimens from Conțești (No. 19, 20), Bucharest (No. 28, 29, 30, 31, 32, 35, 36, 39, 40, 41, 42) and Mangalia (No. 60) are protected and assigned with a low conservation value.

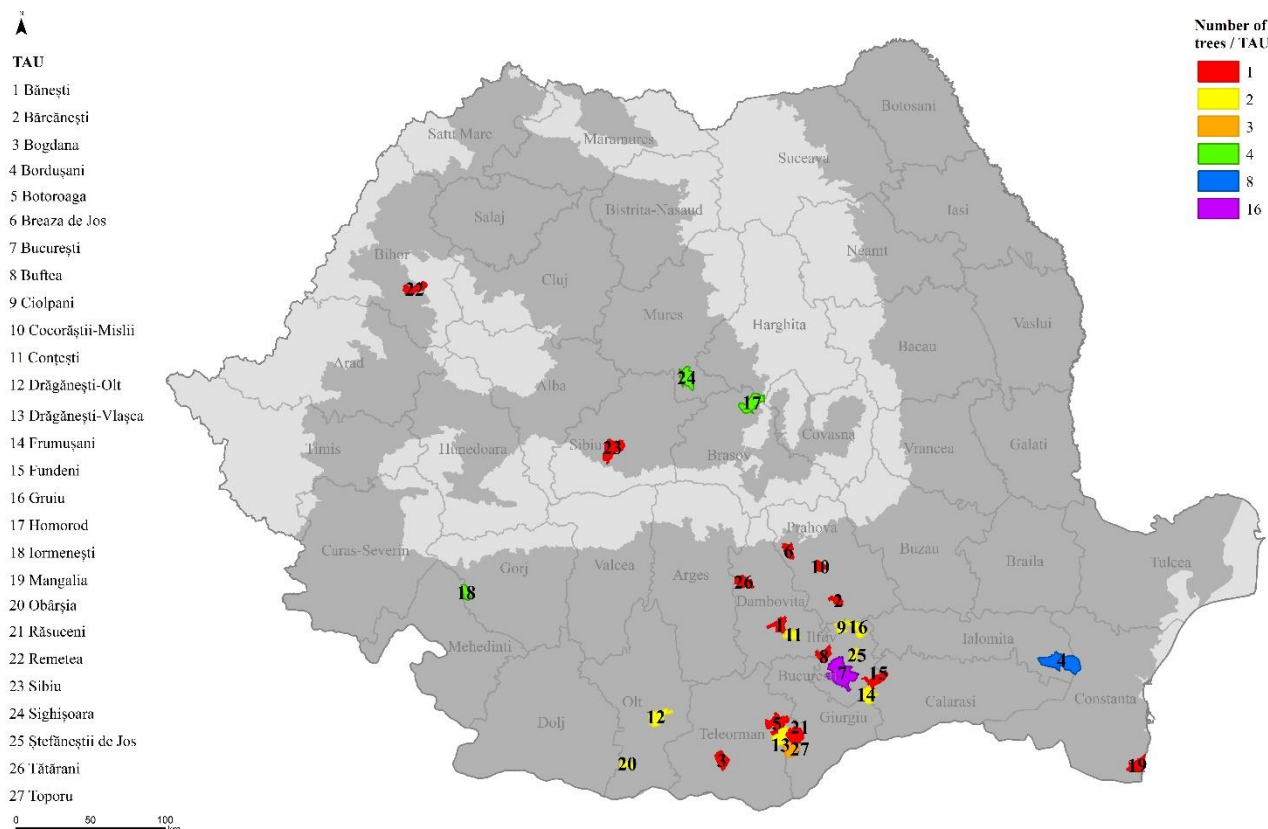


Fig. 2: The location of the remarkable trees identified within the Continental and Steppic Biogeographical Regions of Romania at TAU level (Source: A.N.C.P.I. 2006)

In order to facilitate the discussion session, the 68 specimens analyzed were grouped according to six major forested landscapes based on their spatial distribution: the wooden pastures of Transylvania, the Subcarpathian forests of Muntenia and Oltenia, the forests within the plains of Vlășia and Vlașca, the southern dry oak forests of Muntenia and Oltenia, the flooded forest within the Danube meadows and the silvostepes of Dobrudja. The wooden pastures of Transylvania encompass four TAUs (Mercheașă, Sighișoara, Sibiu and Remetea), a total number of ten remarkable trees, all of them being common oaks (*Quercus robur*). Despite the fact that all the oaks within the pastures of Mercheașă stand out as having a high conservation potential, only one specimen (No. 5) is declared monument of nature, having both protective fence and informative panel. The individual possesses the largest girth within all

the measured trees (930 cm) being consistently larger than the next two trees, No. 6 (760 cm) and No. 7 (660 cm) (Bolea & Vasile 2011). No. 8 reveals as a distinctive feature a very large cave. The oaks are scattered in the proximity of the Homorod Hills SPA which protects numerous bird species, especially night raptors, certifying the areas zoogeographical value (Brânzan 2013). Furthermore, they and many other specimens form one of the largest concentration of several-century old trees within Romania, a solid prove concerning the pastures phytogeographical potential (Hartel et al. 2015, Hartel & Tamaș 2015). The services regarding human communities consists in the presence of a valuable cultural landscape, were buffalo grazing dates back hundreds of years and numerous fortified churches guard medieval villages. The ancient wooded pastures were the subject of numerous

researches concerning their cultural value (Hartel & Moga 2010, Moga et al. 2016). The oaks are integrated in various touristic trails, which connect both geomorphological attractions (such as the Racoș Volcano, the Emerald Lake and Basalt Columns within the Racoș Geopark) and historical ones, namely the fortress of Rupea. Yet, the access is quite precarious due to the lack of touristic infrastructure and mobile signal, the pastures being disposed at a distance of over two kilometers from the isolated village of Mercheașa at the base of the Perșani Mountains.

The oaks of Sighișoara are protected within the Breite plateau secular oaks reserve as part of the SCI Târnava Mare – Sighișoara and form the largest concentration of secular trees of Romania and probably south-central Europe (Bolea & Vasile 2011, Patrut 2011, Brânzan 2013). All of the specimens are assessed as having a high conservation value. The largest specimen has a girth of over 700 cm (No. 1). The plateau stiff rock slopes covered partially by bench forests conserve large carnivore habitats such as bears and wolves (Roelling et al. 2014, Cristescu et al. 2019) while the upper swampy areas protect medieval grasslands. The plateau represents a representative cultural landscape, several trees being carbon dated and estimated as having between 300 and 400 years (Patrut 2011). The presence of Sighișoara fortress, a UNESCO medieval site fulfills the areas historical value while the reserve is accessible through a one kilometer hike starting from the city.

The several centuries old oak within the zoological garden of Sibiu (No. 13) it is assigned as having a medium conservation value. It represents the largest living remain of the relict meadow forest protected in the Dumbrava Sibiului Natural Park and it is stated as a monument of nature (Bolea & Vasile 2011). The forest guards mainly generalist animal species. The presence of the Sibiu historical center and the garden itself which is the oldest in Romania favor the areas historical value.

The largest tree within the county of Bihor is represented by the oak of Remetea (No. 14, 660 cm girth) also protected as a monument of nature. The oak guards the road connecting the historical village of Remetea with the famous Meziad cave, the areas major touristic attraction, located within the Crișul Repede Gorge – Piatra Craiului Mountains SCI (Brânzan 2013). Similarly, the lack of valuable zoological elements in the surrounding forests justifies us to model the tree as having just a medium conservation value.

Four TAUs are located in the Subcarpathian forests of Muntenia and Oltenia, the main species being oaks, sessile oaks, benches (Cococrăști-Misli, Tătărani and Breaza de jos) and exotic oriental planes (Iormănești), totaling seven specimens. The

giant oak of Tătărani (No. 16, 750 cm girth) is protected as monument of nature and characterized by a medium conservation potential, being located in a large forest at the end of three kilometer forest road (Bolea & Vasile 2011). The area is difficult to access and lacks mobile signal. The oak is the largest within the hill forests of Muntenia and it is associated with the historical character of Matei Basarab. A similar status and potential is assessed to the sessile oak of Cococrăști-Misli (No. 15) and to the giant bench of Breaza de Jos (No. 17), both located in Prahova County. The first possesses a 700 cm girth, being sheltered by virgin or quasi-virgin forest areas that favor the presence of common animal species, especially wild boar (Giurgiu 2001). The second presents an 800 cm girth and it is the largest hill forest tree of Romania. It is hidden in the Lazului Hill forest, which also neighbors potential virgin sectors (Giurgiu 2001) and lies in the proximity of a valuable local geomorphological attraction, the Târsa river gorge (Muzeul Județean de Științele Naturii Prahova 2013). Record sizes also characterize the largest oriental plane of Iormănești (No. 9), which reaches over 700 cm girth. The specimen is not protected and possess a high conservation value. The rest of the planes encompassed by the Glogova domain, which also shelters an impressive fortified mansion, form the largest concentration of exotic remarkable tress analyzed. There are located near the Motru River SCI, a proper habitat for numerous amphibians and large mammals (Brânzan 2013).

The mixed oak forests within the Vlășia and Vlașca plains include seven TAUs (Bănești, Conțești, Ghighiu, Buftea, Gruiu, Ciolpani and Bucharest Municipality) and total thirty-five specimens consisting in both autochthonous species (common oak, ash, poplar and lime tree) and introduced ones (mulberry tree and oriental plane) (Călinescu 1969, Ioja 2001, Grigorescu 2010). The poplars of Bănești and Conțești possess just a low conservation potential because their only distinctive feature is the exceptional size, specifically 920 cm girth (No. 18) and 850 cm girth (No. 19, 20), aspect which certifies only their physical value. Only the specimens of Conțești are protected. Two trees that encompass the same potential are the oaks of Ghighiu (No. 21) and Buftea (No. 22), neither being protected. A medium potential was assigned to the oaks of Ciolpani (No. 23, 24) and Gruiu (No. 25, 26) due to the fact that there are located in the proximity of valuable historical monuments, namely the monasteries of Țigănești and Snagov. They are also included in protected areas, such as Scroviștea SCI and Snagov forest reserve, which preserve rare bird species, representative being the lowland eagle (Bolea & Vasile 2011, Brânzan 2013). Particularly, neither of the specimens are stated as monuments of nature.

Bucharest possesses numerous protected trees assigned with a medium (No. 27, 33, 34, 37) or low (No. 28, 29, 30, 31, 32, 35, 36, 39, 40, 41, 42) conservation value. They are some of the largest ashes (No. 27, 640 cm girth), mulberry trees (No. 37, 550 cm girth), lime trees (No. 28) or exotic American oaks (No. 29) within the BCR (ANPM 2009).

The dry oak forests of southern Muntenia and Oltenia shall be separated into four distinct sub regions, each encompassing diferent TAUs: Vlășia (Ștefănești de Jos, Fundeni, Frumușani), Vlașca (Drăgănești-Vlașca, Toporu, Botoroaga, Bujoreni), Deliorman (Bogdana), and Oltenia (Drăgănești-Olt, Obârșia). They total twenty remarkable trees, all of them being dry oaks (*Quercus pedunculiflora*), except one specimen, which is an exotic Japanese accacia. Neither specimen within the Vlășia sub region is protected, despite the fact that the giant oak of Frumușani (No. 46) is the largest within the area (650 cm girth) while the Japanese acacia of Fundeni is the largest of its species measured (370 cm girth). The first is located in the proximity of the Pitar Bridge forest (*Quercus cerris*) which shelter a densely population of wild boar and reindeer (Geacu 2011). The second is disposed near the abandoned historical church of the Gherassy family. Both possess a medium conservation value. The oaks of Ștefănești de Jos (No. 43, 44) are the largest located in mixed forests within the plain (over 4 m girth) (Ioja 2010). They are modelled as having a low conservation potential because they do not offer other values and they are not protected. The Vlașca dry oak sub region consists in specimens which do not benefit by a favorable preservation status, yet some reveal a medium potential, namely the ones of Drăgănești-Vlașca (No. 50, 51) which are difficult to access due to the Dandara-Corneanca forest, a SCI destined to protect an old relict *Quercus cerris* forest and consistent population of wild boar and other cinegetic species (Brânzan 2013). The largest figures on old maps as the oak of Toni, a mysterious

significance (Crăciunescu et al. 2011). The 550 cm girth specific to the oak of Toporu (No. 52) assigns it the title as the largest within the Vlașca plain, while the specimen of Bujoreni (No. 43), historically known as the oak of Pietriș (Crăciunescu et al. 2011) lies in occasionally flooded forest proper to preserve water birds in the Călniștea Valley SPA (Brânzan 2013). Reindeer are common in the forest of Comoara, where the oak of Botoroaga (No. 49) is located (Mustătea 2017). The trees of Deliorman and Oltenia are modelled with a medium potential. The largest forest specimen within Teleorman County is the oak of Bogdana (No. 55, 550 cm girth) associated with Mihai de Brave. It is considered a monument of nature. Similarly, based on our field observations, the gigantic 660 girth *Quercus pedunculiflora* from the Braniștea Catârilor forest is the largest of its specie from Romania (No. 56). Yet, it is very isolated, the forest is one of the best preserved remains of primeval dry oak forest of our country, being protected within the homonymous SCI (Brânzan 2013, Geacu et al. 2018). Drăgănești-Olt protects two secular trees, one being known as the oak of Tudor Vladimirescu (No. 58, 650 cm girth) (Consiliul Local Drăgănești-Olt 2015).

The flooded forest within the Danube meadows reveal a very isolated relict, the Hățis forest of Bordușani, which is the largest concentration of several century old trees of the countries swampy lowlands. There are protected giant oaks (No. 64 with almost 800 cm girth or No. 61 with over 600 cm girth), poplars (No. 68, 850 cm girth) and willows (No. 67, over 600 cm girth) The region is occasionally flooded being impossible to access and lacks touristic infrastructure. It shelters wild boars, jackals and diurnal raptor birds such as hawks due to the Bordușani SPA (Brânzan 2013). Another concentration of old dry oaks it is protected near the forest of Comorova, Mangalia (No. 60) (Bolea & Vasile 2011). The specimens are not remains of the initial silvostepes, being planted over one hundred years.

Table 1: The trees location, year of investigation, conservation potential and protection status



No.: 1
 TAU: Sighișoara
 Year: 2018
 Protected: yes
 Potential: high



No.: 2
 TAU: Sighișoara
 Year: 2018
 Protected: yes
 Potential: high



No.: 3
 TAU: Sighișoara
 Year: 2018
 Protected: yes
 Potential: high



No.: 4
 TAU: Sighișoara
 Year: 2018
 Protected: yes
 Potential: high



No.: 5
TAU: Mercheaşa
Year: 2016
Protected: yes
Potential: high



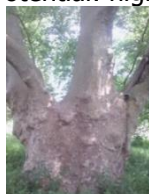
No.: 6
TAU: Mercheaşa
Year: 2016
Protected: no
Potential: high



No.: 7
TAU: Mercheaşa
Year: 2016
Protected: no
Potential: high



No.: 8
TAU: Mercheaşa
Year: 2016
Protected: no
Potential: high



No.: 9
TAU: Iormăneşti
Year: 2015
Protected: no
Potential: high



No.: 10
TAU: Iormăneşti
Year: 2015
Protected: no
Potential: medium



No.: 11
TAU: Iormăneşti
Year: 2015
Protected: no
Potential: medium



No.: 12
TAU: Iormăneşti
Year: 2015
Protected: no
Potential: medium



No.: 13
TAU: Sibiu
Year: 2017
Protected: yes
Potential: medium



No.: 14
TAU: Remetea
Year: 2017
Protected: yes
Potential: medium



No.: 15
TAU: Cocorăşti-Misli
Year: 2015
Protected: yes
Potential: medium



No.: 16
TAU: Tătărani
Year: 2015
Protected: yes
Potential: medium



No.: 17
TAU: Breaza de Jos
Year: 2017
Protected: yes
Potential: medium



No.: 18
TAU: Băneşti
Year: 2015
Protected: not
Potential: low



No.: 19
TAU: Conţeşti
Year: 2015
Protected: yes
Potential: low



No.: 20
TAU: Conţeşti
Year: 2015
Protected: yes
Potential: low



No.: 21
TAU: Bărcăneşti
Year: 2015
Protected: no
Potential: low



No.: 22
TAU: Buftea
Year: 2017
Protected: no
Potential: low



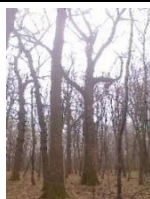
No.: 23
TAU: Ciolpani
Year: 2017
Protected: no
Potential: medium



No.: 24
TAU: Ciolpani
Year: 2017
Protected: no
Potential: medium



No.: 25
 TAU: Gruiu
 Year: 2017
 Protected: no
 Potential: medium



No.: 26
 TAU: Gruiu
 Year: 2017
 Protected: no
 Potential: medium



No.: 27
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: medium



No.: 28
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: low



No.: 29
 TAU: Bucharest
 Year : 2018
 Protected: yes
 Potential: low



No.: 30
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: low



No.: 31
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: low



No.: 32
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: low



No.: 33
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: medium



No.: 34
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: medium



No.: 35
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: low



No.: 36
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: low



No.: 37
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: medium



No.: 38
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: low



No.: 39
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: low



No.: 40
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: low



No.: 41
 TAU: Bucharest
 Year : 2015
 Protected: yes
 Potential: low



No.: 42
 TAU: Bucharest
 Year: 2015
 Protected: yes
 Potential: low



No.: 43
 TAU: Ștefănești de Jos
 Year: 2017
 Protected: no
 Potential: low



No.: 44
 TAU: Ștefănești de Jos
 Year: 2017
 Protected: no
 Potential: low



No.: 45
TAU: Fundeni
Year: 2018
Protected: no
Potential: medium



No.: 46
TAU: Frumușani
Year: 2018
Protected: no
Potential: medium



No.: 47
TAU: Frumușani
Year: 2018
Protected: no
Potential: medium



No.: 48
TAU: Bujoreni
Year: 2018
Protected: no
Potential: medium



No.: 49
TAU: Botoroaga
Year: 2015
Protected: no
Potential: low



No.: 50
TAU: Drăgănești-Vlașca
Year: 2017
Protected: no
Potential: medium



No.: 51
TAU: Drăgănești-Vlașca
Year: 2017
Protected: no
Potential: medium



No.: 52
TAU: Toporu,
Year: 2018
Protected: No
Potential: low



No.: 53
TAU: Toporu,
Year: 2018
Protected: No
Potential: low



No.: 54
TAU: Toporu
Year: 2018
Protected: No
Potential: low



No.: 55
TAU: Bogdana
Year: 2018
Protected: Yes
Potential: medium



No.: 56
TAU: Obârșia
Year: 2018
Protected: Yes
Potential: medium



No.: 57
TAU: Obârșia
Year: 2018
Protected: No
Potential: low



No.: 58
TAU: Drăgănești-Olt
Year: 2015
Protected: Yes
Potential: medium



No.: 59
TAU: Drăgănești-Olt
Year: 2015
Protected: Yes
Potential: medium



No.: 60
TAU: Mangalia
Year: 2016
Protected: Yes
Potential: low



No.: 61
TAU: Bordușani
Year: 2019
Protected: yes
Potential: medium



No.: 62
TAU: Bordușani
Year: 2019
Protected: yes
Potential: medium



No.: 63
TAU: Bordușani
Year: 2019
Protected: yes
Potential: medium



No.: 64
TAU: Bordușani
Year: 2019
Protected: yes
Potential: medium



No.: 65
 TAU: Bordușani
 Year: 2019
 Protected: yes
 Potential: medium



No.: 66
 TAU: Bordușani
 Year: 2019
 Protected: yes
 Potential: medium



No.: 67
 TAU: Bordușani
 Year: 2019
 Protected: yes
 Potential: medium



No.: 68
 TAU: Bordușani
 Year: 2019
 Protected: yes
 Potential: medium

Source: Mustățea Mihai 2015, 2016, 2017, 2018, 2019

Conclusion

Applying an overall perspective, Transylvania stands out as the region encompassing by far the most valuable tree specimens due to the presence of cultural landscapes unique in Romania. Furthermore, the pastures massive concentration of medieval oaks certifies the researcher's interest in terms of both history, ecology and dendrochronology. Conversely, the isolation and poverty that affects these rural regions favors the unfavorable protection status of numerous remarkable trees which are virtually unknown and, consequently, they are not preserved. Therefore, these wooden pastures cluster a major hotspot in terms of suitable candidates for future protection. By comparison, the remarkable trees within Subcarpathian forests do not integrate major cultural landscapes. Despite this fact, they possess complex historical value based on the presence of numerous legends concerning rulers and historical characters. They represent the largest hill forest life forms of the BCR and consist of individual elements without forming notable concentrations. The specimens present a positive preservation status and consequently do not reveal potential vulnerabilities, except the imposing concentration of giant oriental planes of Iormănești, which are not protected. The exemplars scattered in the Vlășia plain are valuable especially due to their association with old historical monasteries, densely sprawled in the forested areas north of Bucharest. All of these trees are accessible based on the proximity to Bucharest. Also, due to the presence of the largest concentration of lowland oak forests of Romania, the trees maintain a notable ecological value. The lack of favorable individual protection arguments the existence of a second major hotspot concerning vulnerable old trees after Transylvania. A similar situation characterizes the southern BCR dry oak forests species, which represent a third potential vulnerable hotspot. Despite the fact that they do not possess the historical significance specific to the

oaks of Vlășia, the southern ones stand out especially due to their impressive size, isolation and consequent natural potential. Yet, many specimens are usually difficult to access due to the rural regions lack of touristic infrastructure. Rural regions within poor Counties, particularly Teleorman, Giurgiu, Olt or Călărași reveal major economic and demographic problems, situation that slows their touristic development and scientific progress. By consequence, the century old trees of these regions will probably remain outside scientific and touristic interest, the chances of them to benefit in the future by a favorable conservation status being extremely low.

Our assessment reveals the presence of one major hotspot concerning areas sheltering high conservation value unprotected century old tree specimens within the BCR, namely the wooden pastures of Transylvania and two less extended but still notable ones, materialized by the vast mixed oak forests within the Vlășia plain and the rare and scarce dry oak forests of Vlașca. Here the specimens are poorly studied and despite their remarkable features, denote an eager need for an enhancement regarding their conservation status.

Acknowledgements

I am deeply grateful to Prof. Univ. Dr. Ileana Stupariu for general suggestions, Dr. Cezar Buterez for field orientation support, Lect. Univ. Dr. Clus Mioara for conceptual guidance, Conf. Univ. Dr. Mihai Răzvan Niță for methodological indications, and Georgian Vladuț Nițu or Brâncoveanu Constantin for trip assistance. The article is dedicated to my grandfather, Osiac Vasile, a passionate history and geography professor in Botoroaga TAU, Teleorman County.

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