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PORTUGAL'S TREES OF PUBLIC INTEREST:
THEIR ROLE IN BOTANY AWARENESS

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ABSTRACT – Based on the classification processes, from 1939 to 2012, of the National Registry for Trees of Public Interest, from the Institute for Nature Conservation and Forests, it was verified that of the 278 municipalities, corresponding to the five Regions of Tourism of mainland Portugal, 130 municipalities do not have classification processes. Considering that is an environmental but also a social gap, the authors understand it is necessary to contribute to the social understanding of monumental trees through the promotion of scientific culture in botany, as an important means to emphasize its value as an endogenous differentiation element of each region. It is also intended to mobilize the general public, to identify and propose the classification of trees with monumental characteristics.

Keywords: Legislation; monumental trees; scientific literacy.

RESUMO – ARVOREDO DE INTERESSE PÚBLICO: PAPEL NA PROMOÇÃO DA BOTÂNICA. Com base nos processos de classificação, compreendidos entre 1939 e 2012, do Registo Nacional do Arvoredo de Interesse Público, do Instituto da Conservação da Natureza e das Florestas, verificou-se que dos 278 municípios, correspondentes às cinco Regiões de Turismo de Portugal Continental, 130 municípios não possuem processos de classificação. Por se considerar ser esta uma lacuna, não só em termos ambientais, como sociais, sentimos a necessidade de contribuir para a compreensão social do arvoredo monumental, através da realização de atividades de promoção da cultura científica, na área da Botânica, como um importante meio para enfatizar o seu valor como elemento de diferen-

ciação endógena das regiões. Também se pretende mobilizar o público em geral, para identificar e propor para classificação árvores com características monumentais.

Palavras-chave: Legislação; árvores monumentais; literacia científica.

RÉSUMÉ – ARBRES DE REMARQUABLE INTÉRÊT PUBLIC: LEUR RÔLE DANS LA SENSIBILISATION DE LA BOTANIQUE. Ayant comme base les processus de classification de 1939 à 2012 du Registre national d' Arbres d'Intérêt Public del'Institut de Conservation de la Nature et des Forêts, nous avons vérifié que, des 278 municipalités correspondant aux cinq régions de Tourisme du Portugal Continental, 130 ne disposent pas de processus de classification. Une fois que nous considérons qu'il s'agit d'une lacune, non seulement environnementale mais aussi sociale, nous ressentons le besoin de contribuer à la compréhension sociale des arbres remarquables à travers des activités de promotion de la culture scientifique, dans le domaine de la botanique, comme un moyen important pour souligner sa valeur en tant qu'élément de différenciation endogène des régions.

Mots clés: Législation; arbres remarquables; culture scientifique.

RESUMEN – ARBOLADO DE INTERÉS PÚBLICO DE PORTUGAL: SU PAPEL EN LA CONCIENCIA BOTÁNICA. Con base en los procesos de clasificación, entre 1939 y 2012, del Registro Nacional de Árboles de Interés Público, por parte del Instituto de Conservación de la Naturaleza y de los Bosques, se verificó que, de los 278 municipios, correspondientes a las cinco Regiones Turísticas de Portugal Continental, 130 municipios no cuentan con un proceso de clasificación. Considerando que esto representa una brecha ambiental y también social, los autores creen que es necesario contribuir al conocimiento social de los árboles monumentales, a través de la realización de actividades de promoción de la cultura científica en Botánica, como un importante medio para enfatizar su valor como un elemento endógeno diferenciado de cada región.

Palabras claves: Legislación; árboles monumentales; cultura científica.

I.   INTRODUCTION

1. Trees of Public Interest: national criteria

Portugal has one of the oldest laws in Europe in the field of tree protection, with the introduction of 'Trees of Public Interest' (Decree Law nº. 28/468, of 15 February 1938). This Decree-Law was repealed by the more recent Law nº. 53/2012 and further regulated by Ordinance nº. 124/2014 which determines the criteria and procedures of classification and declassification of such trees. The *Instituto da Conservação da Natureza e das Florestas* (ICNF) (Institute for Nature Conservation and Forests) is responsible for managing those trees and administrating the related online database: the National Registry for Trees of Public Interest.

A relevant aspect of the Law is a concern with the generalization of the classification procedure. Anyone can propose the classification of isolated trees or arboreal sets

(e.g. tree lined avenue, arboretum, grove, garden, forest stands, woods) as public interest. Another great scope of the Law is related to the criteria for tree classification. It does not rely merely on dendrology parameters such as age and size, or design aspects (e.g. beauty or unusual formation). The Law considers other values that justify the need for careful conservation of trees. Thus, the criteria of selection considers and includes: natural value (e.g. conservation status, abundance, unique individual or existing in small number, with international interest of conservation); historical value (e.g. striking history or relevant national symbolism); cultural value (e.g. elements of belief, memory, collective national imagination or associated with important figures of Portuguese culture); or aesthetic value (e.g. appreciation). These constitute an advantage and innovation in the protection of 'monumental trees', another epithet used by the Institute for Nature Conservation and Forests to refer trees that are distinguished from others of its species by size, design, age, rarity, historical interest or aesthetic classifying them as Trees of Public Interest (TPI). Once classified as of public interest, the grove becomes a living monument and, as such, subject to certain constraints and benefits (Varela & Barros, 1998).

In the national context, trees protected by Law or other trees not yet classified but which might potentially be valued, are designated as 'monumental trees'. However, other names are used (e.g., centenary trees, giant trees), as also happens elsewhere, internationally. For example: in Spain, 'árboles singulares' (Domínguez Lerena, Corchero De La Torre, & Albano Villar, 2012), and 'árboles monumentales' (Parés Español, 2009); in Italy, 'alberi monumentali' (Lisa, 2011); in France, 'arbres remarquables' (Diraison, 2003); or in England, 'ancient trees' (Butler, Rose, & Green, 2001), 'veteran trees' (Nowak, 2004), 'large old tree' (Lindenmayer *et al.*, 2013).

In light of the diversified terminology used in the scientific studies analysed, we use the designation 'monumental trees' for all trees with remarkable characteristics, regardless of whether or not they are protected by Law. However, only those that are protected by Law have the designation "Trees of Public Interest" (TPI).

2. Monumental trees: their value

Trees with notable features represent a heritage the value of which needs to be known and protected for future generations. They have several ecological contributions with direct implications in mitigating climate change. As Stephenson *et al.* (2014) have shown, so called 'large, old trees' actively fix large amounts of carbon compared to smaller trees. Another study by Nowak (2004) examines the high environmental and social benefits of veteran trees, i.e., trees with longevity and significance in landscape, with special dendrometric features. Regardless of the trees species, with ageing arise multiple decadent features, such as cavities, dry and hollow branches, extensive ramifications or complex crowns (Lindenmayer, Laurance, & Franklin, 2012). Those features represent crucial habitats to a large diversity of living beings and, because of that, trees with these specifications are considered a biodiversity hotspot (Lindenmayer *et al.*, 2013). In agricultural

landscapes, those trees restore vegetation, act as a wildlife corridor, attract seed dispersers and pollinators and increase the genetic connectivity between other populations and trees (Lindenmayer *et al*., 2012).

Despite their ecological contributions, monumental trees also have important cultural value due to their aesthetic, spiritual (Pederson, 2010) and health quality (Tsunetsugu *et al*., 2007). They also create social benefits by promoting economic development of rural areas (Moya, 2015) and represent a historical, cultural and religious heritage (Dafni, 2006) that can define the identity of a community. In recent years, this heritage is being explored for its educational and touristic value.

3. Monumental trees: factors of decline

Only in Europe, in the last 100 years, 80% of monumental trees, mature forests and agricultural secular trees have disappeared (Moya, 2015). Several factors explain this decline. Natural threats (Parés Español, 2009; Martins & Travassos, 2012; Moya, 2015) but also human activities can explain the pressure on this heritage: i) habitat fragmentation, isolation, contamination and extinction (Butler *et al*., 2001; Lindenmayer *et al*., 2013), resulting, for instance, in fires (San-Miguel-Ayanz *et al*., 2012), urban renewal (Jim, 2005), and over-exploitation of natural resources (Moya, 2015); ii) lack of legislation (Moya, 2015) and inspection (Domínguez Lerena *et al*., 2012); iii) aggressions, abandonment, negligence and pruning (Domínguez Lerena *et al*., 2012; Martins & Travassos, 2012), or excessive soil compaction (Moya, 2015); iv) lack of understanding of the origin and development of these trees (Moya, 2015); and v) competition with invasive plants (Marchante, Freitas, & Marchante, 2008). These actions affect not only old trees but also young, healthy trees, with implications in the renovation of a new generation of monumental trees.

4. The social perception of monumental trees

To deal with threats that affect plants it is important to increase the social recognition of the value they represent. However, several studies have demonstrated a low social interest in plants. They are forgotten (Yorek, Şahin, & Aydin, 2009) and have been underappreciated, minimized relative to other living things such as animals (Wandersee, 1986 as cited in Sanders, 2007). This lack of interest in plants was described by Wandersee and Schussler (2001), as *plant blindness*, i.e., the inability to see or perceive plants in their environment and recognize their importance.

However, this tendency can be contradicted with the development of actions that contribute to changing behaviours and attitudes towards plants (Fančovičová & Prokop, 2011). Beyond an increase in scientific literacy on plants (Randler, Osti, & Hummel, 2012), it is important that public and private sector stakeholders effectively manage actions geared towards knowledge, protection and dissemination of their value.

Taking monumental trees as a starting point, to know their heterogeneity and specificities would be an important step towards a deeper social understanding of these plants. So, this paper aims to collect and organize information regarding the National Registry for Trees of Public Interest. The specific goals are: i) to quantify TPI; ii) to identify the municipalities with TPI; iii) to understand how this heritage (native and non-native species) is distributed in the territory and whose property they are; iv) to disseminate information about the Law and the National Registry; v) to contribute to increase the scientific literacy about monumental trees.

The results should be useful to provide the public with credible information for use in advocating for improved monumental trees protection policies. Additionally, it is hoped that these results may contribute to developing an integrated programme on scientific communication to increase the interest in monumental trees and the number of trees protected by Law.

II. METHODOLOGY

The universe included in our field of research corresponds to TPI process present in the National Registry for Trees of Public Interest, from the total of 278 municipalities, corresponding to the five regional tourism areas in mainland Portugal, resulting from Lei nº. 33/2013: ('Norte'; 'Centro'; 'Lisboa and the Vale do Tejo'; 'Alentejo'; and 'Algarve'). This division excludes the autonomous regions of Portugal (Madeira and Azores) that have their own jurisdiction. Data analysis by regional tourism areas will provide information for later use in a more in-depth study of the TPI's knowledge at the municipal level, through the application of a survey of municipalities in the regional tourism area of 'Centro'.

The National Registry is an online database, at the ICNF website. This catalogue contains qualitative data and does not show the aggregated numbers of the various information parameters about the trees classified. Thus, it was important to build a global database with systematic information of all mainland territory to, more correctly, interpret the information about the Portuguese TPI. We developed maps using Geographic Information System (GIS) to analyse the data from the National Registry for Trees of Public Interest. Information such as, how many and which municipalities have only isolated trees or arboreal sets, or both, and how many and which municipalities do not have any classification procedures. Also, quantitative descriptive analyses were made to collect various types of information about the TPI like the total number of isolated trees and arboreal sets, their ownership, and also if the classified tree is a native or a non-native species). The native species were selected considering the ICNF user guide for indigenous tree species in mainland Portugal (Do Amaral, Aguiar, Capelo, & Lopes, 2016). The research did not consider the specific number and species' names of the arboreal sets because they are not exhaustively described in the National Registry. Trees mentioned as declassified were not considered in the study.

The study includes all the classification procedures between 1939 (first tree listed), to 2012 (last proposal made). The hiatus since 2012 was brought by the establishment of Law nº. 53/2012. In 2015, the ICNF proceeded to an inspection of all listed trees through an intensive fieldwork maintaining the classification or disqualifying trees that no longer met the conditions to be classified as public interest. Thus, our study crystallizes data for a future more in-depth analysis for different spatial scales.

III. RESULTS AND DISCUSSION

The data analysed are presented in the following three sections.

1. National Registry for Trees of Public Interest database

From the procedures made between 1939 and 2012 (table I), in the universe of 278 municipalities, 470 isolated trees and 81 arboreal sets were quantified in a total of 148 municipalities (53%). The largest owner is the State (66%), with private owners accounting for the remaining 34%. These results reflect the importance of promoting the scientific culture of this natural heritage, as well as the legal mechanisms available to make new classification processes as TPI, to potentially influence in classification processes. The first tree to be listed as public interest, in 1939, a *Pinus pinea* located in Covilhã, was excluded from the database in 1964, with 183 years old, for being dry.

Table I – Distribution and ownership of Trees of Public Interest in mainland Portugal (procedures from 1939 to 2012).

Quadro I – Distribuição e proprietário do Arvoredo de Interesse Público (processos de 1939 a 2012).

Tourism Region	Area (Km²)	Municipalities	Municipalities with classification	Municipalities without classification	Isolated trees*	Arboreal sets*	Ownership Private*	Public*
Norte	21 272	86	43	43	117	25	46	71
Centro	28 203	100	57	43	163	21	50	113
Lisboa e Vale do Tejo	3 013	18	16	2	131	30	36	95
Alentejo	31 606	58	22	36	42	4	22	20
Algarve	4 996	16	10	6	17	1	11	6
Total	89 090	278	148	130	470	81	165	305

*Source: National Registry for Trees of Public Interest from the ICNF

The total of municipalities with TPI can be divided in different groups, as 40% have isolated trees, 11% have both isolated trees and arboreal sets, and 2% have only arboreal sets. 47% of the municipalities have no classification procedures (fig. 1).
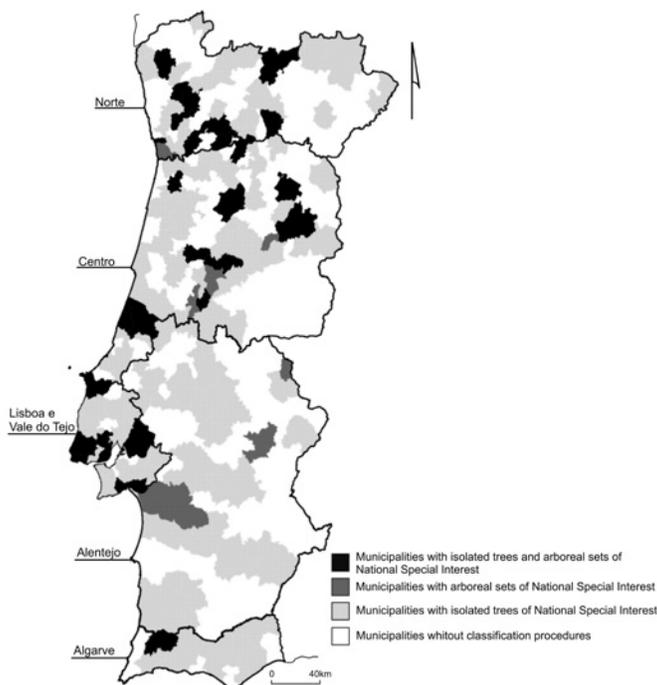
Fig. 1 – Spatial distribution of trees of Public Interest in the five regional Tourism areas in mainland Portugal: i) 'Norte'; ii) 'Centro'; iii) 'Lisboa e Vale do Tejo'; iv) 'Alentejo'; and v) 'Algarve'.

Fig. 1 – Distribuição espacial do Arvoredo de Interesse Público nas cinco áreas regionais de Turismo de Portugal Continental: i) Norte; ii) Centro; iii) Lisboa e Vale do Tejo; iv) Alentejo; e v) Algarve.

A regional comparison of municipalities shows that 'Centro', 'Lisboa e Vale do Tejo' and 'Algarve' have more municipalities with trees listed. The Alentejo region has more municipalities without trees listed and in the 'Norte' region there is no difference. The fact that the southern regions of the country have the lowest number of classified trees may have some ecological significance.

However, the results show that approximately half of the municipalities do not have listed trees. In fact, it is important to improve general knowledge about such trees to increase new classification procedures. This is consistent with Costa, Sobral, Viana, Fernandes, and Barracosa, (2005), claiming that TPI are unknown by most of the Portuguese population and it is necessary to focus on raising their awareness.

In all of the territory where TPI are found, isolated trees are more abundant. The distribution occurs essentially in the 'Centro', 'Lisboa' and 'Norte'. The 'Lisboa' region, despite having the smallest area, contains the largest number of listed trees which may be related to greater ease and access to knowledge, which makes people and institutions better able to promote the classification of trees in this region. The 'Alentejo' and the 'Algarve' regions had the lowest number of trees classified (fig. 2).
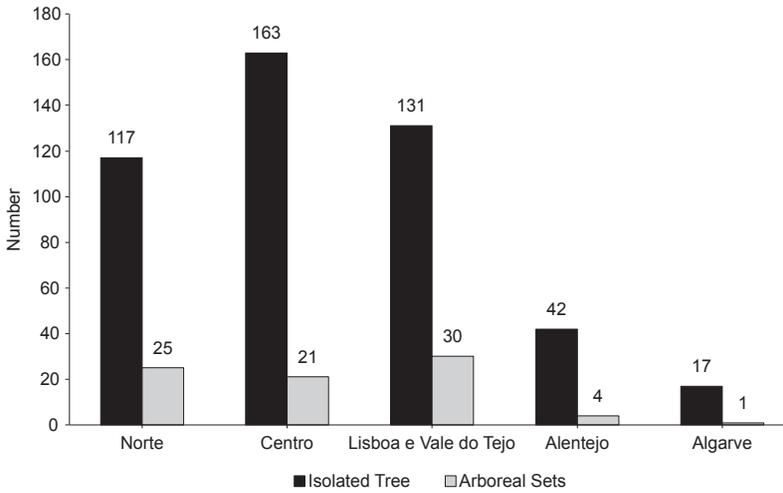
Fig. 2 – Isolated trees and arboreal sets of National Public Interest in the five regional Tourism areas in mainland Portugal.

Fig. 2 – Árvores isoladas e conjuntos arbóreos do Registo Nacional do Arvoredo de Interesse Público presentes nas cinco áreas regionais de Turismo de Portugal Continental.

Regarding the distribution by ownership (fig. 3), it can be seen that the larger portion of TPI belongs to the public administration, in 'Norte' and 'Centro' of the territory. Private ownership is greater in 'Alentejo' and 'Algarve'. This can be related to the large private farms ('latifundia') existing in the South of the country.
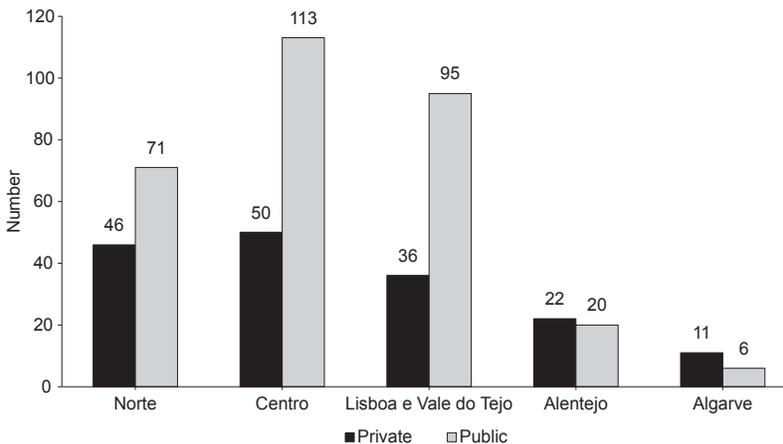

Fig. 3 – Private and Public ownership of Trees of Public Interest in the five regional Tourism areas in mainland Portugal.

Fig. 3 – Proprietários privados e públicos do Arvoredo de Interesse Público, nas cinco áreas regionais de Turismo de Portugal Continental.

Considering the isolated native species (47%), the most frequent species were *Pinus pinaster* (21%), *Quercus suber* (20%) and *Quercus robur* (14%). Also well represented are the species: *Pinus pinea* (8%), *Castanea sativa* (6%), *Fraxinus angustifolia* (5%), *Quercus faginea* (5%), *Taxus baccata* (4%), *Populus nigra* (4%) and *Quercus ilex* subsp. *rotundifolia* (4%) (table II). These species are representative of the main arboreal flora in mainland Portugal that, according to the 6th National Forest Inventory (NFI), represents 70% of the wooded area of the country (IFN6, 2013), influenced by the Atlantic and Mediterranean climates (Ribeiro, Lautensach, & Daveau, 1991; Fabião & Oliveira, 2006).

Table II – Isolated native species of Trees of Public Interest in mainland Portugal.

Quadro II – Espécies nativas das árvores isoladas classificadas de Arvoredo de Interesse Público em Portugal Continental.

Scientific Name	Total	Regional Area				
		Norte	Centro	Lisboa e Vale do Tejo	Alentejo	Algarve
Pinus pinaster Aiton	47	2	37	8		
Quercus suber L.	45	11	16	6	8	4
Quercus robur L.	32	22	10			
Pinus pinea L.	17	3	3	6	3	2
Castanea sativa Mill.	13	8	4	1		
Fraxinus angustifolia Vahl	11		8	1	2	
Quercus faginea Lam.	11		7	3	1	
Taxus baccata L.	9	4	3	2		
Populus nigra L.	8		5	3		
Quercus ilex L. subsp. *rotundifolia* Lam.	8	1	3	1	2	1
Celtis australis L.	3			3		
Ilex aquifolium L.	3	3				
Quercus pyrenaica Willd.	3	1	2			
Quercus canariensis Willd.	2					2
Ulmus sp. L.	2		2			
Alnus glutinosa L.	1		1			
Arbutus unedo L.	1		1			
Ceratonia siliqua L.	1					1
Juniperus oxycedrus L.	1	1				
Myrica faya (Ait.) Wilbur	1		1			
Olea europaea L. var. *sylvestris* (Mill.) Hegi.	1				1	
Populus alba L.	1		1			
Pyrus communis L.	1		1			
Total	222	56	104	35	17	10

Source: National Registry for Trees of Public Interest from the ICNF

From isolated non-native species (53%), the most frequent species are *Platanus x hispanica* (11%), *Olea europaea* var. *europaea* (9%), *Dracaena draco* (6%), *Eucalyptus globulus* (6%), *Araucaria* spp. (5.6%) and *Camellia japonica* (4%) (table III). The diversity and abundance of non-native species found denote a historical memory and the increased

ornamental exotic plant commerce through time. In fact, the transport of the first non-native plants to Portugal took place in prehistory, and later, in the Roman period (Vicente *et al.*, 2018). However, it was during the sixteenth century, with the maritime expansion to other continents, that non-native species have been significantly introduced in Portugal (Ferreira, 2004; Vicente *et al.*, 2018), for studying the possibility of acclimatizing new productive cultures in Portugal (Vandelli, 1770). Their abundance has increased during the last two centuries, and today represent more than 15% of the Portuguese flora (Almeida & Freitas, 2001).

Table III – Isolated non-native species of Trees of Public Interest in mainland Portugal.

Quadro III – Espécies não-nativas das árvores isoladas classificadas de Arvoredo de Interesse Público em Portugal Continental.

Scientific name	Total	Regional area				
		Norte	Centro	Lisboa e Vale do Tejo	Alentejo	Algarve
Platanus x *hispanica* Mill. ex Münchh.	28	6	8	11	2	1
Olea europaea L. var. *europaea*	23		2	5	13	3
Dracaena draco L.	14		1	13		
Eucalyptus globulus Labill.	14	4	9		1	
Camellia japonica L.	11	9	2			
Araucaria heterophylla (Salisb.) Franco	9	4	2		1	2
Ficus macrophylla Desf. ex Pers.	9			9		
Liriodendron tulipifera L.	8	7	1			
Metrosideros excelsa Banks ex Gaertn.	8	2		6		
Cedrus atlantica (Endl.) Carrière	7	4	2	1		
Magnolia grandiflora L.	6	1	5			
Cedrus deodara (Roxb. ex D. Don) G. Don	5	3	1	1		
Cupressus lusitanica Mill.	5	1	3	1		
Cupressus macrocarpa Hartw. ex Gordon	5			5		
Erythrina crista-galli L.	5			5		
Pinus jeffreyi Balf.	5		1	4		
Araucaria bidwillii Hook.	4	1	2	1		
Melaleuca armillaris (Sol. ex Gaertn.) Sm.	4	1	1	1	1	
Sequoia sempervirens (D. Don) Endl.	4	1	2	1		
Tilia tomentosa Moench	4		3		1	
Tipuana tipu (Benth.) Kuntze	4			4		
Platanus orientalis L.	3	2		1		
Phoenix dactylifera L.	3			3		
Phytolacca dioica L.	3		1	1	1	
Sequoiadendron giganteum (Lindl.) J. Buchholz	3		3			
Aesculus hippocastanum L.	2		1	1		
Ceiba crispiflora (Kunth) Ravenna	2			2		
Ceiba speciosa (A.St.-Hil.) Ravenna	2			1	1	
Cupressus sempervirens L.	2	2				
Ficus benjamina L.	2			2		

Fraxinus excelsior L.	2		2			
Ginkgo biloba L.	2	1		1		
Grevillea robusta A.Cunn.,ex R.Br.	2			2		
Lagunaria patersonii (Andr.) G. Don	2			2		
Pistacia lentiscus L.	2				2	
Phoenix canariensis Chabaud	2			2		
Wisteria sinensis (Sims) DC.	2		2			
Acer negundo L.	1			1		
Araucaria columnaris (G. Forst.) Hook	1			1		
Brachychiton sp. Schott & Endl.	1			1		
Carpinus betulus L.	1	1				
Casuarina cunninghamiana Miq.	1					1
Cercis siliquastrum L.	1	1				
Chamaecyparis lawsoniana (A. Murray) Parl.	1	1				
Chorisia crispiflora Kunth	1			1		
Cinnamomum camphora (L.) J. Presl	1		1			
Eucalyptus camaldulensis Dehnh.	1				1	
Eucalyptus diversicolor F.Muell.	1		1			
Eucalyptus obliqua L'Hér.	1		1			
Jubaea chilensis (Molina) Baill.	1			1		
Juglans nigra L.	1	1				
Juglans regia L.	1	1				
Melaleuca styphelioides Sm.	1			1		
Ocotea foetens (Aiton) Benth. & Hook.f.	1		1			
Platanus occidentalis L.	1	1				
Pinus canariensis C. Sm.	1			1		
Pittosporum undulatum Vent.	1		1			
Prunus laurocerasus L.	1	1				
Pseudotsuga menziesii (Mirb.) Franco	1	1				
Quercus coccinea Münchh.	1	1				
Quercus rubra L.	1	1				
Schinus molle L.	1	1				
Schinus terebenthifolius Raddi	1			1		
Taxodium distichum (L.) Rich.	1			1		
Vitex agnus-castus L.	1			1		
Washingtonia filifera (Lindl.) H. Wendl.	1			1		
Wollemia nobilis W. G. Jones, K. D. Hill & J. M. Allen	1				1	
Total	248	60	59	97	25	7

Source: National Registry for Trees of Public Interest from the ICNF

2. Native species as Trees of Public Interest

From the results obtained it is possible to establish a comparison between the distribution of native species from the Mediterranean Region, present in the National Registry, and their natural geographical distribution in mainland Portugal, influenced by Mediterranean and Atlantic conditions (Rego & Rocha, 2014):

i)   in Atlantic influenced areas, it is verified the presence of *Quercus robur* (the third most abundant species listed) and the presence of *Quercus pyrenaica*, a species that covers the transition between the Atlantic and Mediterranean regions, North coast and, Middle Eastern, respectively, corresponding to the 'Norte' regional area;

ii) in the deciduous woods (or cork oak 'montado') the *Quercus suber*, the second most abundant species in the National Registry. This species, part of the natural vegetation of the Iberian Peninsula, has high economic, cultural and ecological importance, and is the most represented native tree of the total forested area in Portugal (737 000ha; 23%) (Capelo & Catry, 2007; IFN6, 2013). Deciduous trees also include: *Quercus ilex*, another species occurring in all regional areas, representing 11% of total forest area (IFN6, 2013); *Arbutus unedo*, with only one occurrence in the 'Centro' region; and *Olea europaea* var. *sylvestris* ('zambujais'), a native species, with sole presence in the Alentejo. This tree is a spontaneous species of the cultivated non-native olive tree (*Olea europaea* var. *europaea*);

iii) the marcescent woods are characterized by the presence of *Quercus faginea* existing in the 'Centro', 'Lisboa' and 'Alentejo' and *Quercus canariensis*, the rarest of the oak-species, typical of humid areas of the western Mediterranean, occurring only in the 'Algarve' mountains;

iv) mediterranean forests of conifers: *Pinus pinaster*, occurring in 'Norte' – 'Centro', is the most abundant species listed. Most of this type of classified tree occurs in the 'Centro', corresponding to the 'National Forest of Leiria', an area of historical pine plantations. In fact, throughout the 19th century, Portugal went through a so--called 'pinheirização' (intensive plantation of *Pinus pinaster*), to address an intense deforestation of the past centuries due to: fires, slashing and burning of agricultural and pastoral areas, and also promoted by the Portuguese Maritime Expansion, that occurred between the 16th and 18th centuries (Devy-Vareta, 1986; Paiva, 1997; PNDFCI, 2005). This would lead to the largest continuous patch of pine forest in Europe, which was further promoted during the 20th century (Capelo & Catry, 2007). These facts probably contributed to the development of notable examples. Nowadays, this species occupies the third position of the total forest area (714 000ha; 23%) with important economic value due to the exploration of resin, wood and pulp (Capelo & Catry, 2007; IFN6, 2013). *Pinus pinea* is the fourth most abundant species listed, represented in all regional areas. It carries social, aesthetic and economic value, by the shape of its crown and its seed, the pine seed (Capelo & Catry, 2007). With 175 000ha, it represents 6% of all forest area (IFN6, 2013);

v)   riparian forests of *Alnus glutinosa*, *Populus* spp., and *Fraxinus angustifolia* more represented in the 'Centro' and 'Alentejo' (Fabião & Oliveira, 2006; Capelo & Catry, 2007; Do Amaral *et al.*, 2016).

Other native species analysed, despite having lower representation in the National Registry, have, over the time, gained important economic, cultural and ecological roles in rural communities, such as: i) *Castanea sativa*, survived from the glaciations of the Iberian Quaternary in small sheltered areas around the Peninsula (found in the palynological records) has been cultivated since Roman times, now is represented in the eastern Northern and Central of the territory, covering 1% of the forest area, 41 000ha (Maia, 1988; Gomes-Laranjo, Anjos, Pinto, Ferreira-Cardoso, & Peixoto, 2009; IFN6, 2013); ii) *Ceratonia siliqua*, only present in the 'Algarve' has an important fruit production (carob) (IFN6, 2013).

Other species have a unique presence in the National Registry. *Pyrus communis*, exclusive to 'Gerês' and 'Cabreira' mountains (North Portugal), have a sole occurrence in the 'Centro', which evidences an old area of cultivation. Also, *Myrica faya*, which occurs mainly in the sandy pine forests of the 'Centro' regional area, and *Juniperus oxycedrus* considered one of the most important ornamental Portuguese conifers, well adapted to hot and dry regions of the North (Fabião & Oliveira, 2006; Do Amaral *et al.*, 2016).

There are other species with a special status of protection, due to national or European law, including: *Ilex aquifolium*, *Taxus baccata*, *Quercus canariensis; Juniperus* spp.; *Quercus rotundifolia*; and *Quercus suber* elected the Portuguese National Tree (Do Amaral *et al.*, 2016).

Ulmus spp. was included as a native species, despite not being mentioned in the National Registry they are specifically restrictive. According to prior studies, *Ulmus minor* was, until a few decades ago, a very common species in all of Portugal. Unfortunately, it has been decimated by successive new strains of the dutch elm disease (*Ophiostoma* spp.) (Do Amaral *et al.*, 2016), and maybe these can explain the two instances, existing as isolated trees, in the 'Centro'.

3. Non-native species as Trees of Public Interest

From the results obtained of non-native trees, it is possible to understand how the history of Portugal was important in diversifying the species existing today in the National Registry. Several species have been introduced during the Roman occupation (Rosa, 2013). *Platanus* spp. was one such species, widely planted in parks and along streets in southern Europe and Asia Minor to improve the microclimate (Pourkhabbaz *et al.*, 2010). In Portugal, its abundance – as the most frequent species in the National Registry – reflects its ornamental use. *Olea europaea* L. var. *europaea*, the second most abundant non-native species listed, considered one of the oldest permanently cultivated species since Pre-history, is very common in Mediterranean regions with an agricultural use and high economic and social impact (Bohm, Godinho, & Coelho, 2013; Moya, 2015).

Another frequent species, except in the 'Lisboa' and 'Algarve', is *Eucalyptus globulus*. This species has an economic value, especially in the paper pulp industry, that makes it dominant in terms of occupation of the total forest area in the country (812 000ha, 26%) (Alves, Pereira, & Silva, 2007; IFN6, 2013).

The 'Lisboa' regional area has a high abundance and diversity of non-native species compared with the others areas. This can be explained by the botanical interest during the period of maritime expansion, which led to the creation of the first Portuguese botanical garden – the Ajuda Botanical Garden –, to receive the new plants coming from other continents, during the 18th century. In the 19th century, the botanical collection was expanded to private gardens belonging to the Royal Family and then came in use in public gardens and in the thoroughfares of cities. Later, these species were planted in many places in the country (Rosa, 2013). So, for instance, *Dracaena draco* is represented in the 'Centro' and 'Lisboa' regional areas, although its occurs mostly in Lisboa, where *Ficus* spp. and other non-native species have an exclusive representation.

Camellia japonica, *Phoenix canariensis*, *Araucaria* sp. and *Wisteria sinensis* are species with ornamental interest, and during the 16th century, during the maritime expansion, an interest in exotic species was born throughout Europe (Saraiva, 2007; Rosa, 2013). Other species, common as gardening plants for their ornamental value, are present in our data: *Liriodendron tulipifera*, *Metrosideros excelsa* and *Magnolia grandiflora*.

A few palm trees of different species were also classified as TPI. Unfortunately, some are presently being declassified by the ICNF after the attack by the insect *Rhynchophrus ferrugineus*, commonly known as red palm weevil.

4. National Registry for Trees of Public Interest database and tourism

Other information made by the technicians of the Institute of Nature Conservation and Forests regards to trees with special interest to be included in tourist routes, like for instance the champions trees, such as:

– in height (72m), an *Eucalyptus diversicolor*, located in 'Coimbra', considered the highest specimen in Europe;
– in crown diameter (50.50m), an *Eucalyptus globulus*, located in 'Braga';
– in age (2 850 years), an *Olea europaea* L. var. *europaea*, located in 'Loures';
– in trunk diameter at breast height (DBH, 14.4 m), a *Castanea sativa*, located in 'Vila Pouca de Aguiar'.

But also, other monumental trees have potential and are referenced to tourism and educational exploration. This information is especially important in rural areas, taking into account that nature tourism assumes a sustainable revitalization activity for those territories (Luís, 2002; Milheiro *et al.*, 2014). The diversification of tourism, with the development of itineraries through monumental trees, can provide an opportunity for emphasizing its value, as an endogenous differentiation element of each region by renewed popular knowledge (agricultural practices, pastoralism, forestry or gastronomy), as well as the appreciation of local cultural curiosities (legends, religious reasons). This is consistent with Costa *et al.* (2005) study, which suggested that tourist routes allow the trees to be preserved as living monuments, contributing simultaneously to the tourist, economic, historical and heritage development of the regions where they are located.

V. CONCLUSIONS AND FURTHER RESEARCH

The analyses of the National Registry brought knowledge on the reality of trees classified. The results show that public proposals for classification of monumental trees do not occur in the whole of the mainland territory, since almost half of municipalities have no TPI, despite the national legislation and the fact that the largest owner is the State. Also of interest to note is their distribution in the territory, which reflect the diversity of the Portuguese forest, and its evolution, influenced by the introduction of non-native species. The results obtained jointly with the lack of information, in the general population, but also from public institutions, on tree classification, requires a careful reflection on the importance of this heritage that is not known and not assumed as a national strategy for promotion and differentiation of the regions. This constitutes a gap, because the current legislation sustains guidelines for an effective classification procedure and protection of monumental trees, where anyone can start a new classification proposal.

Considering the importance of reversing these trends, a larger experimental study is being implemented, to assess the impact of science communication projects on increasing public awareness of monumental trees. The study is divided in three main research areas. Firstly, collecting and analysing institutional data (legislation), at national and European, concerning the valorisation and protection of trees with notable features. In a second moment, identifying national actions developed at institutional levels regarding knowledge, attitudes and opinions on monumental trees and assess the degree of action in relation to the current legislation, as well as diagnose the main communication strategies developed for the promotion of the knowledge of the monumental trees to the public and also identifying the main barriers to non-investment in this area. In this sense, a questionnaire will be carried out in the 100 municipalities from 'Centro' regional area. In a third moment, developing and evaluating the impact of methodologies to involving different target audiences in science communication programmes, in the context of non-formal education, where botanical activities were the focus. Some of these projects will be capitalized to promote tourist itineraries, at the same time is promoted scientific literacy.

Collecting information about monumental trees was important to understand how to emphasize their potential. By representing the living memory and identity of a community, this heritage can be taken as a catalyst for local development and also to be used for promotion of scientific culture in botany, contributing to counteract the plant blindness phenomenon.

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