

# National inventories of crop wild relatives and wild harvested plants: case-study for Portugal

Joana Magos Brehm · Nigel Maxted ·  
Brian V. Ford-Lloyd · Maria Amélia Martins-Loução

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**Abstract** Crop wild relatives (CWR) and wild harvested plant species (WHP) constitute an important element of a nation's plant genetic resources (PGR) available for utilisation. Although their natural populations are threatened like other wild species by habitat lost and fragmentation, little attention has generally been paid to their systematic conservation. The development of checklists and inventories is considered by the convention on biological diversity (CBD) and the global strategy for plant conservation (GSPC) as the first step in any national strategy for conservation and sustainable use of plant diversity. Methodological approaches to the development of a national inventory of wild PGR are discussed in the light of a case-study for the CWR and WHP growing in mainland Portugal. The resultant inventory comprises 2319 taxa, of which 97.5% are CWR, 21.4% are WHP and 19.0% are both CWR and WHP. Approximately 6.1% are endemic to

mainland Portugal; 24.1% occur in 1 to 4 Portuguese administrative regions; 15.6% are threatened, but only 5.9% are covered by legislative protection. Taxonomic misalignments and the dispersed nature of biological literature were the major impediments to the production of the national inventory, but once the inventory was established it has proven to be a powerful tool in conservation management.

**Keywords** Conservation · Databases · Management tool · Methodologies · Plant genetic resources

## Introduction

Crop wild relatives (CWR) are those taxa related to species of direct socio-economic importance, including food, fodder and forage crops, medicinal plants, condiments, ornamental and forestry species, as well as plants used for industrial purposes such as oils and fibres (Kell et al. 2007). They are components of both natural habitats and agroecosystems and may contain desirable genes that can enhance pest resistance, or improve the nutritional value or flavour of crops (IPGRI 1993). Hajjar and Hodgkin (2007) have recently reviewed how CWR have been used for crop development and improvement in the last 20 years. Maxted et al. (2006) provided a working definition for CWR derived from the gene pool concept proposed by Harlan and de Wet (1971),

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J. Magos Brehm (✉) · N. Maxted · B. V. Ford-Lloyd  
School of Biosciences, University of Birmingham,  
Edgbaston, Birmingham B15 2TT, UK  
e-mail: JXM372@bham.ac.uk

J. Magos Brehm · M. A. Martins-Loução  
Museu Nacional de História Natural, Jardim Botânico,  
Universidade de Lisboa, R. Escola Politécnica 58,  
Lisboa 1250-102, Portugal

M. A. Martins-Loução  
Centro de Ecologia e Biologia Vegetal, Universidade de  
Lisboa, Campo Grande C2. Piso 4, Lisboa 1749-016,  
Portugal

which, in the absence of crossing and genetic diversity information, involved the use of a taxonomic hierarchy based on degree of relatedness. Thus they define a CWR as “... a wild plant taxon that has an indirect use derived from its relatively close genetic relationship to a crop; this relationship is defined in terms of the CWR belonging to gene pools 1 or 2, or taxon groups 1 to 4 of the crop”.

Wild harvested plants (WHP) are non-cultivated species that are collected from the wild and used by local people. These species are particularly used as food, medicines and fibres sources, as may also play key roles in cultural traditions (Plants for a Future 1996–2003). Sheldon et al. (1998) estimated that approximately 85% of medical treatment in developing countries employs traditional medicines, 85% of which involves plants extracts (Farnsworth 1988). This means that close to 3 billion people rely on WHP to meet their medical needs. Moreover, in Europe and North America the use of herbal medicines has been increasing at a steady rate of at least 15% (Lavania 2005). According to Farnsworth and Soejarto (1991) ca. 9200 of 33000 species of monocots, dicots, gymnosperms, pteridophytes, bryophytes and lichens were documented to have ethnomedical uses. These numbers suggest that about 28% of world's plant species have been used ethnomedically. Also, Lavania (2005) mentioned that about 6000 of plant species are broadly used in traditional, folk, herbal and modern medicines either directly or indirectly as a source of active compounds or as a chemical lead for the synthesis of important biomolecules.

The development of species checklists and inventories is seen as a first step to effective conservation (GSPC and CBD 2002; Mace 2004). A checklist is a means of organising information in a logical and retrievable way, preventing duplication of effort when planning conservation actions that enable the sustainable use of plants (RBG 2004). Furthermore, species checklists are considered a valuable tool for exploration, surveys and collection of PGR of both crop species and wild plants (Hammer 1991; Prendergast 1995).

In terms of CWR, the first step to produce an inventory was taken by Davis et al. (1994) with a preliminary list of wild relatives of European cultivated plants, which was superseded by Heywood and Zohary's (1995) more comprehensive checklist of 206 species and subspecies in the primary wild

gene pool of native European cultivated species. More recently, Kell et al. (2005, 2007) developed the PGR Forum Crop Wild Relative Catalogue for Europe and the Mediterranean, which comprises about 25,687 CWR and crop taxa (<http://cwr.is.ecpgr.org/>). At the national level, Mazzola et al. (1997) produced the first CWR inventory for Italy (with 163 species), Chauvet et al. (1999) a list of 130 CWR species for France, Smekalova (pers. comm. 2005) a list of 1603 CWR species occurring in Russia, and Mitteau and Soupizet (2000) prepared a list of wild species for *in situ* conservation with 44 species within 23 genera. Also, Maxted et al. (2007) produced a CWR catalogue for the United Kingdom derived from the PGR Forum Crop Wild Relative Catalogue for Europe and the Mediterranean (Kell et al. 2007).

Hegi (1931) was the first author to produce a catalogue for WHP. His work is comprehensive and covers several hundred useful plants for Central Europe, including medicinal, ornamental, food, feed and fibre plants. In 1975, Zeven and Zhukovsky made an attempt to list the wild PGR for Europe, excluding ornamentals and forestry resources. Schlosser et al. (1991) compiled a list of useful plants classified by main use that was derived from the list of wild plants of Central Europe. A total of 980 species was listed, 28% ornamental and turf, 23% medicinal plants, 19% wood, 8% fruit, and 7% fodder plants. Lange (1998) studied the medicinal plants native to Europe (comprising 1200–1500 species). Saunderson and Prendergast (2002) and Prendergast and Saunderson (2004) made a compilation of WHP for England and Scotland, and Allen and Hatfield (2004) studied the medicinal plants in the folk traditions of Britain and Ireland. Furthermore, an online database of native and naturalized plants of the Mediterranean was developed by the Medusa Network (2002) (<http://medusa.maich.gr/network/>). The database includes a detailed evaluation of the current utilisation of these plants together with information concerning their conservation status, geography of use and the chemistry of the compounds involved, supported with bibliographical references, when available.

#### The Portuguese context

In Portugal, the lack of an inventory of wild PGR has been a major constraint to their conservation. A

cultivated species list does not exist except for ornamental plants (see Pimenta 2004), and only the major crops are included in national statistics. Therefore, a CWR inventory could not be directly derived from a cultivated species list.

From the WHP perspective, the Instituto da Conservação da Natureza (ICN, Portugal) is currently undertaking a national inventory of the aromatic and medicinal plants occurring within the Portuguese national network of protected areas (<http://portal.icn.pt/ICNPortal/vPT/>). Another project named ‘Study and conservation of the Portuguese ethnobotanical patrimony’ focused on the collection, study, conservation and dissemination of traditional uses of plant species in Portugal (<http://www.esab.ipbeja.pt/museu/etnobotanica.htm>). However, a great deal of bibliographic information regarding WHP is dispersed and needs compilation to make it user friendly.

In this paper, we aim to review the process of making a national inventory for CWR and WHP, thus contributing to the development of practical methodologies for conservation and sustainable use of these species. We also discuss methodological limitations and constraints. As a case-study, this paper also presents data from the CWR and WHP occurring in Portugal together with information related to its native status, national and global distribution, national and international legislation affecting the species under study, ethnobotanical uses, conservation status (*ex situ* and *in situ* conservation), economic category to which the related crops belong, and threatened status.

## Methods

### Portuguese CWR

The initial database of Portuguese CWR was developed from a geographically filtered list from the PGR Forum Crop Wild Relative Catalogue for Europe and the Mediterranean (Kell et al. 2005). Four major existing sources of information were utilised as the backbone of the European and Mediterranean catalogue of CWR: Mansfeld’s Database of Agricultural and Horticultural Crops (Hanelt and IPK 2001; IPK 2003) for cultivated plants, Schultze-Motel (1966) for forestry genera, the Community Plant Variety Office

(CPVO) (Kwakkenbos pers. comm. 2004) for ornamental genera and the Medicinal and Aromatic Plant Resources of the World Database (MAPROW) (Schippmann pers. comm. 2004) (which includes wild harvested as well as cultivated medicinal and aromatic plant species). The genera identified in these four references were compiled and then matched with the taxa for these genera found within the Euro+Med PlantBase (version January 2005) (<http://www.euromed.org.uk>). The PGR Forum Crop Wild Relative Catalogue for Europe and the Mediterranean was then created and the country list could be extracted (see Kell et al. 2007).

To ensure that all the genera of important crops as well as the crops grown in Portugal were included in the database, several documents were used for validation. These include: the complete list of agricultural, vegetables, fruits and ornamental species produced by the Portuguese National Catalogue of Varieties (DGPC 2003), the Temperate and Boreal Forest Resources Assessment 2000 (TBFA-2000) (UNECE/FAO 2000) for the forestry crops; a priority list of ornamental genera representing the recommendations from the Herbaceous Ornamental Crop Germplasm Committee (HOCGC) (OPGC 2002), and also the report by Pimenta (2004) on an updated list of ornamental plant species grown in Portugal. Both native and non-native (introduced) taxa were included in this inventory. The inclusion of non-native species was a pragmatic decision based on these plants’ importance in the development of national economy, namely to increase the diversity and availability of genetic resources for food and agriculture (e.g. potato and maize) (Ministério do Ambiente 1999).

### Portuguese WHP

National ethnobotanical literature on uses was examined and WHP were then added to the database of CWR to constitute the Portuguese CWR and WHP inventory. References include from as early as 1886 with J. de Mendonça’s *Plantas úteis dos campos de Portugal* (Useful plants of the fields of Portugal), as well as more recent literature such as Sommer (2003) and its *Um estudo sobre a flora aromática e medicinal utilizada pela população residente na área do Parque Natural de Sintra-Cascais e zonas envolventes* (Study on aromatic and medicinal flora utilised

by the local population of the Natural Park of Sintra-Cascais). See the inventory of CWR and WHP available at <http://www.jb.ul.pt> for the whole list of references used in this study.

### Taxonomic harmonization

The final list of taxa was taxonomically harmonized with the *Flora Iberica* (Castroviejo et al. 1986–2005) and *Flora de Portugal* (Franco 1971–1984; Franco and Rocha Afonso 1994–2003) for those families still not covered by *Flora Iberica*. Taxon names were cross-checked and confirmed, and new taxa were added whenever they were not included in the PGR Forum catalogue. Synonyms were recognised with the help of *Flora de Portugal* (Coutinho 1939), *Flora de Andalucía* (Valdés et al. 1987), *Flora Portuguesa* (Sampaio 1988) and Euro+Med PlantBase (2005) (<http://www.euromed.org.uk>).

### Additional information in the inventory

Once the nomenclatural information was complete, additional information was added to the CWR and WHP database. This information includes: taxonomic data (such as taxa accepted names, authority, and synonyms), vernacular names, native status data, cultivated status, economic category of related crops, ethnobotanical uses, national and global distribution, *in situ* conservation status, *ex situ* conservation status (obtained through a genebank survey) (see Appendix 1 for the list of genebanks surveyed and online databases consulted), threat assessment, and legislation (see Table 1). The information was compiled in a Microsoft Access Version 2003 database and is available at <http://www.jb.ul.pt>. Figure 1 synthesises the generation of the Portuguese Database of CWR and WHP

## Results

The final inventory includes 2319 taxa (including subspecies and varieties) of CWR and WHP that is about 77% of the total Portuguese flora. From these, around 97.5% of the taxa are CWR (2262 taxa), 21.4% are WHP (497), and 19% are both CWR and WHP (440). According to Kell et al. (2007), the PGR

Forum Crop Wild Relative Catalogue for Europe and the Mediterranean has a total of 25,687 taxa, of which 2204 are crops and 23483 are CWR. The number of CWR obtained in this study represent about 9.6% of the European and Mediterranean CWR flora and 7.3% of the European and Mediterranean total flora (Kell et al. 2007). The number of WHP represents around 1.6% of the Euro-Mediterranean region Flora.

The starting point of the CWR list of taxa was a country-filtered list of the European and Mediterranean CWR Catalogue generated by Kell et al. (2005). This version of the Catalogue (of January 2005) includes about 3280 CWR taxa for Portugal while the inventory developed in this study comprises 2262 CWR. This difference is mainly due to taxonomic misalignments. After the harmonisation of the Euro+Med taxonomy (the taxonomic backbone of the PGR Forum Crop Wild Relative Catalogue for Europe and the Mediterranean) with the *Flora Iberica* (Castroviejo et al. 1986–2005) and the *Flora de Portugal* (Franco 1971–1984; Franco and Rocha Afonso 1994–2003) relevant differences were found. From the 3280 names included in the PGR Forum extracted list for Portugal, 305 are crops. The remaining differences are mainly due to specific and infra-specific synonyms of either one of the two Portuguese (Franco 1971–1984; Franco and Rocha Afonso 1994–2003) and Iberian Flora (Castroviejo et al. 1986–2005), repeated names, orthographic variants or errors, and to those species considered by the Euro+Med to occur in Portugal but not actually present according to the Portuguese and Iberian Flora. Several species and subspecies that were not considered in the Euro+Med PlantBase but accepted either in *Flora Iberica* and *Flora de Portugal* were also added. Four genera were missing, the genus *Aster* L., a priority genus for ornamental plants according to the Ornamental Germplasm Plant Center (OPGC 2002), as well as the genera *Alyssum*, *Armeria* and *Lunaria* included in a recent study by Pimenta (2004). The lack of ornamental genera was also noted by Kell et al. (2007). According to these authors, the CPVO list, (Kwakkenbos pers. comm. 2004) which was used as the backbone of the ornamental genera of the European and Mediterranean Catalogue, is not representative of the total number of cultivated ornamental species, and if other sources of data were consulted, the numbers would increase substantially.

**Table 1** Additional information added to each taxa of the inventory

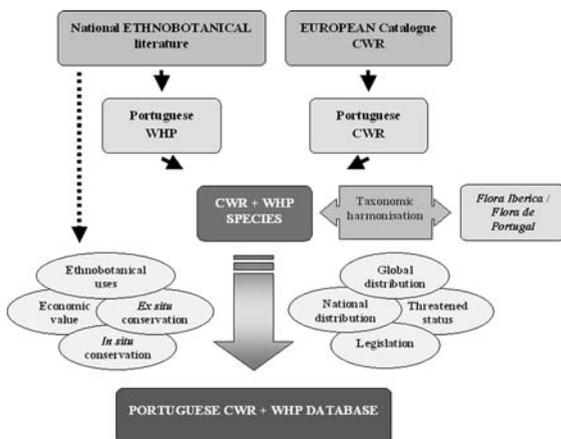
Inventory information	Explanation	Categories
Species name and authors	Accepted species name and authors.	–
Synonyms	Non-accepted species names.	–
Vernacular names	Popular names at national level.	–
CWR/WHP	Whether the taxon is a CWR, a WHP, both, or if it is also sometimes cultivated.	(i) CWR, (ii) WHP, (iii) CWR+WHP, (iv) CWR+WHP+crop
Cultivated status	If the taxon is also cultivated in Portugal.	–
Native status	Whether the taxon is native to the country, introduced or if is of uncertain nativity.	(i) native, (ii) doubtfully native, (iii) introduced
Type of introduction	Whether the introduced taxa are archaeophytes (introduced before the 1500s), neophytes (introduced after the 1500s), diaphyte (established in a non-permanent way) <sup>a</sup> , and also if it has an invasive behaviour.	(i) archaeophyte (ii) neophyte, (iii) diaphyte <sup>a</sup> , (iv) invasive (potentially invasive, dangerous invasive, very dangerous invasive <sup>b</sup> ), (v) doubtful type of introduction
CWR	If CWR taxa are included in previous CWR checklists	–
Economic category	To each genus an economic category was ascribed taking into consideration, whenever possible, the category of the related crop as being cultivated in Portugal; for those crops included in the inventory but not reported as being cultivated in Portugal, the crop category was assigned according to the European common catalogue (EU 2003a, b) and to the Mansfeld <sup>c</sup> World Database (Hanelt and IPK 2001).	(i) food, (ii) fodder/forage, (iii) industrial, (iv) forestry, (v) aromatic and medicines, (vi) ornamental, (vii) other uses
Ethnobotanical uses	Traditional uses for both CWR and WHP.	(i) Aromatic, (ii) beauty, (iii) condiments, (iv) dyes, (v) environmental, (vi) food and drink, (vii) forage and fodder, (viii) fibres and materials, (ix) melliferous, (x) medicinal, (xi) ornamental, (xii) poisonous or toxic plants, (xiii) religious and magic uses, (xiv) repellents, (xv) others
Global distribution	Global distribution of each individual taxon; related to the level of endemism; each species was categorised for its global distribution.	(i) Portugal, (ii) Iberian Peninsula, (iii) Iberian Peninsula + 1 country, (iv) Iberian Peninsula + North Africa, (v) Iberian Peninsula + North Africa + 1 country, (vi) Mediterranean, (vii) Europe/World
National distribution	The national administrative regions where each taxon occurs.	–
<i>Ex situ</i> conservation status	Whether the taxa are represented by seed accessions being held in national and/or international genebanks.	–
<i>In situ</i> conservation status	If active <i>in situ</i> conservation projects are being undertaken in national territory.	–

**Table 1** continued

Inventory information	Explanation	Categories
Legislation	Whether the taxon is under any kind of national or international legislation.	(i) Habitats' Directive, (ii) Bern Convention, (iii) European Council 1977/1983, (iv) national legislation
Threat assessment	Information related to taxa threat assessment (IUCN Red Listing) as well as on taxa endangered by overexploitation.	

<sup>a</sup> Sensu Kornas (1990)

<sup>b</sup> Invasive taxa categories according to Ministério do Ambiente (1999)



**Fig. 1** Generation of the Portuguese CWR and WHP database

The 2319 taxa are distributed across 524 genera and 122 families. While the number of WHP taxa (497) is much lower than that of CWR (2262), surprisingly, the number of families represented by WHP is about 80% of the total number of families of the inventory, reflecting the highly diversified use of different families for traditional uses. The high number of CWR genera (473) is explained by the fact that European and Mediterranean Catalogue of CWR (Kell et al. 2005), from which the Portuguese list of taxa was derived, includes not only the genera of species that are currently cultivated in the country but also those that are cultivated world-wide. Nevertheless, the “top five families” of CWR in Portugal are the Fabaceae, followed by the Asteraceae, Poaceae, Lamiaceae and Caryophyllaceae. They account for almost 40% of the total number of CWR taxa. The first three families are extremely diverse in the Portuguese Flora and comprise the highest number of taxa and genera. From the “top five” CWR families, the genera with highest number

of taxa include *Trifolium* (51 taxa), an important forage genus, *Carex* (44), another forage genus, *Ranunculus* (41), related to a forage crop but also used for food, *Silene* (41) related to ornamentals, *Euphorbia* (33) related to ornamental species, *Centaurea* (32), related to medicinal and ornamental species, *Vicia* (30), also related to food, forage and medicinal plants, and *Juncus* (30) related to fodder crops. At the other extreme, many genera are only represented by a single taxon in Portugal; these include *Arnica* and *Marrubium*, both related to medicinal plants, *Sorghum*, related to forage crops, and *Agrostemma*, whose crop is used in the production of alcohol (IPK 2003).

In terms of WHP, the “top families” represented by the highest number of taxa include Asteraceae, Lamiaceae, Fabaceae, Apiaceae, Brassicaceae and Rosaceae. They account for 39% for the total number of WHP. The genera with the largest number of WHP taxa include: *Thymus* (12 taxa), *Hypericum* and *Rumex* (7), *Erica*, *Malva*, *Mentha* and *Polygonum* (6). Table 2 allows the comparison between the number of genera and species (including subspecies and varieties) between the “top ten families” of CWR and WHP.

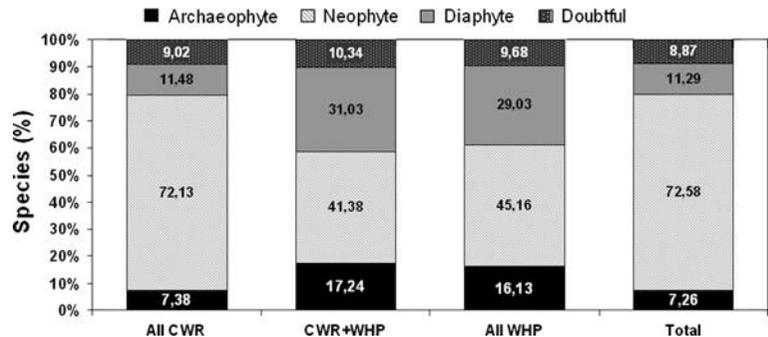
Approximately 92.9% of the CWR and WHP are native, 5.3% are introduced and 1.8% are of uncertain nativity. Figure 2 shows the proportions of different categories of introduced taxa. See Table 1 for the explanation of the main categories for the introduced species. Neophytes and diaphytes are shown to have the greatest percentage of the introduced taxa for all of the inventory. Also considered was if the introduced species were invasive, that is to say, if they tend to excessively occupy a territory, in area or number of individuals, causing adverse changes in the habitats and ecosystems (Ministério do Ambiente

**Table 2** Comparison of the “top ten families” of CWR and WHP; families in descending order of number of species (including subspecies and varieties)

CWR			WHP		
Families	Number of genera	Number of species	Families	Number of genera	Number of species
Fabaceae	33	264	Asteraceae	34	51
Asteraceae	49	233	Lamiaceae	19	46
Poaceae <sup>a</sup>	48	209	Fabaceae	23	33
Lamiaceae	25	95	Apiaceae	18	22
Caryophyllaceae	9	93	Brassicaceae	17	22
Scrophulariaceae	9	86	Rosaceae <sup>a</sup>	13	22
Brassicaceae	29	80	Caryophyllaceae	11	15
Apiaceae	27	74	Ranunculaceae	9	14
Cyperaceae <sup>a</sup>	4	71	Scrophulariaceae	7	13
Ranunculaceae	11	71	Polygonaceae <sup>a</sup>	2	13

<sup>a</sup> Families that do not occur on both lists

**Fig. 2** Percentage of archaeophytes, neophytes, diaphytes, and doubtful CWR and WHP taxa (native status data obtained from Almeida 2005 and Ministério do Ambiente 1999)



1999). Surprisingly, nearly 50% of introduced CWR and WHP are invasive and from these about 39% are considered to be dangerous or very dangerous (according to Ministério do Ambiente 1999).

For purposes of classification, about 31.5% of the taxa are primarily considered as wild relatives of aromatic and medicinal crops or as wild taxa that are harvested and used for aromatic and medicinal purposes. These are followed by those taxa primarily considered as food plants with 27.7%, ornamentals (20.6%), forages and fodder (17.3%), other uses (1.4%), industrial crops (0.9%), and forest trees (0.6%). It should be mentioned that each taxon may have several uses and, thus, could be included in additional use categories.

Analysing the ethnobotanical uses of WHP, we observed a considerable number of taxa (408) used as traditional medicines (Table 3). This is clearly the most common use of the Portuguese WHP. Second is

use for religious purposes and for food, with 96 taxa, followed by ornamentals with 95. The ‘dyes’ category was the smallest with 21 taxa. It is important to stress that the use categories are not exclusive. The Asteraceae, Lamiaceae, Fabaceae, Apiaceae, Brassicaceae and Rosaceae are the families traditionally most used as WHP in Portugal.

Approximately half the listed taxa have a cosmopolitan distribution. These are followed by the Mediterranean endemic taxa with 15.2% (358 taxa) and those endemic to the Iberian Peninsula with 11.4% (256) (Table 4). The Portuguese endemics constitute 6.1 % (141) of the total (see Appendix 2).

The number of provinces in which each taxon occurs can be considered an indication of their rarity. Based on the administrative regions system established in 1936 Portugal has 11 provinces. While about 50% of the taxa have no national distribution data, from the data that are available, 181 out of 2319

**Table 3** Overview of WHP use categories in descending order of total number of taxa; major families and number of taxa (between brackets)

Use categories	Major families and number of taxa	Total number of taxa
Medicine	Asteraceae (45), Lamiaceae (39), Brassicaceae (20), Fabaceae (19), Apiaceae (18), Rosaceae (18), Polygonaceae (12), Ranunculaceae (12), Caryophyllaceae (10), Liliaceae (10), Scrophulariaceae (9), Ericaceae (8), Clusiaceae (7), Malvaceae (7), Euphorbiaceae (6), Orchidaceae (6), Papaveraceae (6), Poaceae (6), Resedaceae (6)	408
Food	Asteraceae (13), Lamiaceae (13), Rosaceae (9), Brassicaceae (8), Apiaceae (6), Polygonaceae (5), Fabaceae (3), Urticaceae (3), Malvaceae (3)	96
Religious and magic	Lamiaceae (13), Asteraceae (6), Ericaceae (5), Fabaceae (5), Rosaceae (5), Liliaceae (4)	96
Ornamental	Ericaceae (8), Lamiaceae (7), Asteraceae (6), Rosaceae (5), Amaryllidaceae (4), Caprifoliaceae (4), Fabaceae (4), Caryophyllaceae (3), Liliaceae (3), Oleaceae (3), Pinaceae (3)	95
Fibre and material	Fabaceae (10), Ericaceae (6), Fagaceae (4), Oleaceae (4), Salicaceae (4), Pinaceae (3)	57
Forage/fodder	Fabaceae (9), Ericaceae (7), Asteraceae (5), Malvaceae (4), Papaveraceae (3), Polygonaceae (3), Urticaceae (3)	52
Aromatic	Lamiaceae (21), Asteraceae (5), Rutaceae (3), Anacardiaceae (2), Apiaceae (2), Fabaceae (2)	50
Poison	Ranunculaceae (8), Apiaceae (5), Asteraceae (5), Solanaceae (4), Apocynaceae (2), Aristolochiaceae (2), Papaveraceae (2), Rutaceae (2)	43
Environmental	Ericaceae (6), Fabaceae (6), Asteraceae (5), Pinaceae (3), Fagaceae (2), Polygonaceae (2), Salicaceae (2)	37
Condiment	Lamiaceae (17), Apiaceae (3), Brassicaceae (3), Fabaceae (2)	32
Other	Lamiaceae (6), Rosaceae (3), Apiaceae (2), Boraginaceae (2), Caryophyllaceae (2), Dipsacaceae (2), Fabaceae (2)	31
Bee plant	Lamiaceae (8), Ericaceae (7), Fabaceae (4)	24
Beauty	Lamiaceae (4), Asteraceae (3), Caprifoliaceae (3), Caryophyllaceae (2), Malvaceae (2)	23
Repellent	Lamiaceae (7), Apocynaceae (2), Crassulaceae (2), Rutaceae (2)	22
Dye	Betulaceae (2), Ericaceae (2), Fagaceae (2), Papaveraceae (2)	21

**Table 4** CWR and WHP' global distribution: percentage (%) of taxa occurring in different geographic units

Level of endemism	All CWR	All WHP	Total
Portugal	6.2	3.0	6.1
Iberian Peninsula	11.5	4.6	11.4
Iberian Peninsula+1 country	3.2	3.0	3.3
Iberian Peninsula +North Africa	7.6	5.0	7.6
Iberian Peninsula +North Africa+1 country	0.8	0.6	0.8
Mediterranean	15.1	17.9	15.5
Europe/World	52.8	63.0	52.5
Missing data	2.9	2.8	2.8

taxa occur in 1 province, 131 in 2 provinces and 147 in 4 provinces. About 24.1% of the taxa occur in between 1 and 4 Portuguese provinces.

From the survey undertaken to several genebanks and online databases (see Appendix 1), only 12% of the taxa (280) are being conserved *ex situ* in national and international genebanks (see the inventory available at <http://www.jb.ul.pt> for the genebanks holding *ex situ* accessions of Portuguese CWR and WHP). From these, about 98.6% are CWR, 29.3% are WHP and about 27.9% are both CWR and WHP. However, this number might be an underestimate, as some genebanks failed to provide data and also due to the fact that online databases might not be updated. The families with the most taxa represented by *ex situ* accessions are the Fabaceae with 101 taxa, followed by the Poaceae with 30 and the Scrophulariaceae with 15. The genus *Trifolium* is the genus with the highest number of taxa (30) represented by seed accessions, followed by *Vicia* (16), *Medicago* (14), *Lathyrus* (11), *Linaria* (10), *Narcissus* (8), *Daucus* with 7 taxa and *Amaranthus* (7 taxa, 5 of which are invasive

species). There are few seed accessions of Portuguese and Iberian Peninsula endemic taxa, particularly from the genera *Allium*, *Calendula*, *Daucus*, *Linaria*, *Lupinus*, *Narcissus*, and *Thymus*.

The information available for active *in situ* conservation is quite sparse and not readily available. However, from the available data only 0.5% (11 taxa) of the taxa is being actively conserved *in situ* because they are rare species rather than being CWR or WHP. In fact, even where species are known to occur within the national network of protected areas, they are not actively being conserved and monitored.

From the 2319 taxa comprising the inventory, only 137 (around 5.9%) fall under any kind of legislation. Of these, 112 taxa are only CWR, 2 are only WHP and 23 are both CWR and WHP. According to the data, 97 CWR and WHP are listed in Appendix II, IV, or V of the Habitats Directive (Council Directive 92/43/EEC 1992), which is a European Union directive that aims to protect some 220 habitats and approximately 1000 species considered to be of European interest and that are listed in the directive's Appendices. From these 97 taxa, 11 are considered as "Priority" taxa. These include the following CWR: *Armeria rouyana* Daveau, *Asphodelus bento-rainhae* P. Silva, *Astragalus algarbiensis* Bunge, *Convolvulus fernandesii* P. Silva et Teles, *Eryngium viviparum* Gay, *Linaria ficalhoana* Rouy., *Linaria ricardoi* Cout., *Ononis hackelii* Lange, *Silene rothmaleri* P. Silva, and the following CWR+WHP: *Thymus camphoratus* Hoffm. et Link, and *T. cephalotos* L. Appendix 1 of the Bern Convention on the Conservation of European Wildlife and Natural Habitats (Council Decision 82/72/EEC 1981) lists 30 taxa, the Council of Europe List of rare, threatened and endemic plants in Europe (Council of Europe 1977, 1983) lists 70, and 9 taxa are protected under national legislation. Of the 137 taxa protected under some form of legislation, 97 are either endemic to Portugal or to Iberian Peninsula and 43 occur in 1 or 2 administrative provinces.

About 15.6% of the taxa included in the inventory are considered threatened. Using the most recent red list data based on the IUCN red list categories and criteria (IUCN 2001, 2003) (Magos Brehm et al. 2007), 1 taxon was considered to be Extinct (EX), and for the threatened categories, 22 taxa were assessed as Critically Endangered (CR), 49 as Endangered (EN), and 36 as Vulnerable (VU). Also,

from a study undertaken earlier by Aguiar et al. (2001a, b), 4 CWR and/or WHP were considered to be EX, 13 CR, 23 EN, 50 VU. 187 taxa were recorded as threatened by other authors using earlier IUCN categories (Dray 1985; SNPRCN 1985; Ramos Lopes and Carvalho 1990; Govaerts 1994; Alves et al. 1997) (see inventory of CWR and WHP available at <http://www.jb.ul.pt> for the references used in this exercise). Furthermore, there are 64 taxa considered to be threatened by overexploitation (Ramos Lopes and Carvalho 1991; Alves et al. 1999) and include mainly taxa of the genera *Narcissus*, *Thymus*, and *Lavandula*.

## Discussion

The development of the CWR and WHP inventory for Portugal was time consuming and sometimes difficult because additional information on native and cultivated status, economic category of related crops, ethnobotanical uses, national and global distribution, *in situ* and *ex situ* conservation status, threat assessment, and legislation was sparse and sometimes difficult to access. However, now that the inventory has been assembled only an update will be necessary to maintain it. Following Hammer's (1991) insightful comments, our information has been entered into a computerized database to facilitate updates and the exchange of information within the PGR community and among other interested researchers.

In relation to CWR, the PGR Forum Crop Wild Relative Catalogue for Europe and the Mediterranean (Kell et al. 2005) proved to be a good starting point for the inventory, particularly since a national list of cultivated taxa does not exist. However, a taxonomic harmonization with national floras is an issue because the adoption of a standardized European taxonomy is far from complete, and an official checklist of the Portuguese flora has not been published and hence more than one flora had to be consulted.

Another issue deserving special consideration is the fact that the PGR Forum Crop Wild Relative Catalogue for Europe and the Mediterranean (Kell et al. 2005), the starting point for the Portuguese CWR inventory, is inclusive rather than exclusive. This means that not only wild relatives of crop

species grown in Portugal, but also those cultivated outside the country (Europe and Mediterranean) will be listed, as well introduced and invasive species, which leads to a very extensive CWR list. This stems from the great number of crop species included in Mansfeld's World Database (Hanelt and IPK 2001; IPK 2003), Schultze-Motel's forestry list (1966), the CPVO list (Kwakkenbos pers. comm. 2004), and the MAPROW (Schippmann pers. comm. 2004), the fundamental documents that provided the crop genera for Kell et al. (2005). In reality, if a breeder wants to improve a particular crop for a specific characteristic, then that breeder is likely to search for the best, cross-compatible sources for that characteristic irrespective of geographic origin and may never have use for a wild relative native to a particular country, such as Portugal.

Regarding the inventory of the Portuguese WHP, we aimed at collating not only recent ethnobotanical references but also old references, so past knowledge would not be lost. But the dispersed nature of relevant biological literature as well as doubtful information was shown to be a fundamental problem in developing an inventory of this kind.

This paper describes one approach for making a national inventory of CWR and WHP. We are aware that the best approach will depend upon the information available for each country. But overall, the most important implications of this kind of work are that each country should produce baseline data about the taxa present and their actual and potential value and, thus, they should be able to prioritise their PGR for posterior conservation actions. In Portugal, once this inventory was created, the next crucial step has been to develop species prioritisation protocols, so important wild PGR can then be more effectively managed and conserved. The Portuguese inventory of CWR and WHP includes about 77% of the national flora and we are aware that such a high number of taxa raise the inevitable question of if this inventory is a useful management tool for the conservation of these groups of taxa. Firstly, it is important to know which resources are available in a particular country, otherwise we wouldn't know if there is any that need particular attention and immediate action. How we then decide which ones are priorities for conservation is an important and crucial step. Financial and human resources are usually the main limiting factors for the development of conservation biology studies and

implementation of conservation activities (Abramowitz 1994), and to conserve nearly 80% of the Portuguese flora is impractical. The species risk of extinction is confidently the major factor usually taken into consideration when selecting priority taxa. However, Maxted et al. (1997) discussed the importance of other criteria: current conservation status, socio-economic use, threat of genetic erosion, genetic distinctiveness, ecogeographic distribution, biological importance, cultural importance, cost, feasibility and sustainability, legislation, ethical and aesthetic considerations, and priorities of the conservation agency. Flor et al. (2006) developed five sets of indicators (based on threat, conservation, genetic, and utilization) to assist in the selection of European CWR priority species. Furthermore, there have been various attempts to devise indices and develop methodologies to help setting conservation priorities (e.g. Master 1991; Dhar et al. 2000).

In resume, in order to prioritise PGR for conservation two fundamental questions need to be answered: (i) which criteria are most important to take into consideration when setting priorities? and (ii) what methods should we use to achieve the desired outcome? There isn't a single answer to these questions. It is inevitable that prioritisation will vary according to the needs and interests of a particular region (country, region, etc...). The process will vary between countries according to available information, local perceptions and development objective (UNEP 1995). However prioritisation is achieved and whatever criteria are used, the total number of priority species must be reduced to that which can be actively conserved using the available resources.

## Conclusions

1. The development of inventories is an important first step in any national strategy for the conservation of CWR and WHP. National checklists/inventories allow us to characterise a country's richness concerning these resources.
2. Our inventory provides baseline information on the CWR and WHP in Portugal. As it is intended to be a useful tool for conservation managers and other researchers, the inventory was made available at <http://www.jb.ul.pt>.

3. Around 77% of the Portuguese flora is potentially useful either indirectly as a gene source for plant breeding and improvement (CWR) or directly in traditional and popular uses (WHP). The importance of conserving these resources is twofold: they may provide useful genes for the improvement of varieties in the future, and they will also serve to maintain the knowledge and sustainable supply of wild useful plants ensuring the diversity of uses as much as possible.
4. Establishment of a national inventory of wild PGR, such as CWR and WHP, can be very intensive and time-consuming. Nevertheless, once this task is completed, it becomes a powerful tool for nature conservation management helping us in setting priorities and subsequently establishing conservation programmes.
5. An inventory that includes nearly 80% of the total national flora needs to undergo through a process of prioritisation. Whichever the criteria and the method used for this purpose, the high number of taxa obtained with this study should be reduced in order to identify those elements that need immediate conservation action.
6. Genetic erosion, as a result of anthropogenic action or due to climate change is likely to have an increasing impact on inter- and intra- specific diversity. Therefore, wild PGR might be affected

not only by climate change but also by the increase of habitat destruction, fragmentation and degradation. As such, studies of the kind described here offer a means of enhancing conservation of biodiversity for use by future generations.

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## Appendix 1

### Genebanks and online databases surveyed

#### Genebanks surveyed

Acronym	Institution
BS-UPM	Banco de Semillas de la Universidad Politécnica de Madrid (Spain)
ENMP	Estação Nacional de Melhoramento de Plantas, Elvas (Portugal)
ISA	Banco de Sementes, Instituto Superior de Agronomia, Lisboa (Portugal)
MSB	Millennium Seed Bank, Wakehurst Place (United Kingdom)
MNHN	Banco de Sementes António Luís Belo Correia, Museu Nacional de História Natural, Lisboa (Portugal)

#### Online databases consulted

Name of database	Webpage
AusPGRIS (Australian Plant Genetic Resources Information Service)	<a href="http://www2.dpi.qld.gov.au/extra/asp/auspgris/">http://www2.dpi.qld.gov.au/extra/asp/auspgris/</a> (accessed March 2005)

**Appendix 1** continued

## Online databases consulted

Name of database	Webpage
ECP/GR European Central Crop Databases: <i>Agrostis</i> , <i>Allium</i> , <i>Arrhenatherum</i> , <i>Brassica</i> , <i>Bromus</i> , <i>Dactylis</i> , <i>Festuca</i> , <i>Lathyrus</i> , <i>Lactuca</i> , <i>Lolium</i> , <i>Lupinus</i> , <i>Phleum</i> , <i>Trifolium</i> , <i>Trisetum</i> , Minor Forage Legumes. European Cooperative Programme for Crop Genetic Resources Network	<a href="http://www.ipgri.cgiar.org/links/ecpgr_search.asp">http://www.ipgri.cgiar.org/links/ecpgr_search.asp</a> (accessed March 2005)
EURISCO, European PGR Search Catalogue	<a href="http://eurisco.ecpgr.org/">http://eurisco.ecpgr.org/</a> (accessed March 2005)
IPGRI Directory of Germplasm Collections (International Plant Genetic Resources Institute)	<a href="http://web.ipgri.cgiar.org/germplasm/report.asp">http://web.ipgri.cgiar.org/germplasm/report.asp</a> (accessed March 2005)
SINGER (System-wide Information Network for Genetic Resources)	<a href="http://singer.grinfo.net/">http://singer.grinfo.net/</a> (accessed March 2005)

**Appendix 2**

## CWR and WHP endemic taxa of mainland Portugal

Family	Taxon name	CWR/WHP
Amaryllidaceae	<i>Narcissus fernandesii</i> G. Pedro	CWR+WHP
Amaryllidaceae	<i>Narcissus scaberulus</i> Henriq.	CWR
Apiaceae	<i>Angelica angelicastrum</i> (Hoffmanns. et Link) Cout.	CWR
Apiaceae	<i>Daucus carota</i> L. subsp. <i>halophilus</i> (Brot.) A. Pujadas	CWR
Boraginaceae	<i>Echium creticum</i> L. subsp. <i>algarbiense</i> R. Fernandes	CWR
Boraginaceae	<i>Myosotis retusifolia</i> Rocha Afonso	CWR
Caryophyllaceae	<i>Dianthus cintranus</i> Boiss. et Reut. subsp. <i>barbatus</i> R. Fern. et Franco	CWR+WHP
Caryophyllaceae	<i>Dianthus cintranus</i> Boiss. et Reut. subsp. <i>cintranus</i>	CWR
Caryophyllaceae	<i>Dianthus loricifolius</i> Boiss. et Reut. subsp. <i>marizii</i> (Samp.) Franco	CWR
Caryophyllaceae	<i>Herniaria algarvica</i> Chaudhri	CWR
Caryophyllaceae	<i>Herniaria lusitanica</i> Chaudhri subsp. <i>berlengiana</i> Chaudhri	CWR
Caryophyllaceae	<i>Herniaria maritima</i> Link	CWR
Caryophyllaceae	<i>Silene cintrana</i> Rothm.	CWR
Caryophyllaceae	<i>Silene foetida</i> Sprengel subsp. <i>foetida</i>	CWR
Caryophyllaceae	<i>Silene longicilia</i> (Brot.) Otth.	CWR
Caryophyllaceae	<i>Silene rothmaleri</i> P. Silva	CWR
Cistaceae	<i>Cistus ladanifer</i> L. subsp. <i>sulcatus</i> (Demoly) P. Monts.	CWR
Asteraceae	<i>Centaurea aristata</i> Hoffmanns. et Link subsp. <i>aristata</i>	CWR
Asteraceae	<i>Centaurea aristata</i> Hoffmanns. et Link subsp. <i>exilis</i> (J. Arènes) Dostál	CWR
Asteraceae	<i>Centaurea aristata</i> Hoffmanns. et Link subsp. <i>geresensis</i> (J. Arènes) Dostál	CWR
Asteraceae	<i>Centaurea coutinhoi</i> Franco	CWR
Asteraceae	<i>Centaurea crocata</i> Franco	CWR
Asteraceae	<i>Centaurea herminii</i> Rouy. subsp. <i>herminii</i>	CWR

## Appendix 2 continued

Family	Taxon name	CWR/WHP
Asteraceae	<i>Centaurea herminii</i> Rouy. subsp. <i>lusitana</i> (J. Arènes) Franco	CWR
Asteraceae	<i>Centaurea limbata</i> Hoffmanns. et Link subsp. <i>geresensis</i> (J. Arènes) Franco	CWR
Asteraceae	<i>Centaurea nigra</i> L. subsp. <i>rivularis</i> (Brot.) Cout.	CWR
Asteraceae	<i>Centaurea rothmalerana</i> (J. Arènes) Dostál	CWR
Asteraceae	<i>Centaurea sphaerocephala</i> L. subsp. <i>lusitanica</i> (Boiss. et Reut.) Nyman	CWR
Asteraceae	<i>Centaurea vicentina</i> Mariz	CWR
Asteraceae	<i>Cynara algarbiensis</i> Mariz	CWR
Asteraceae	<i>Hieracium peleteranum</i> Mérat subsp. <i>vansoesti</i> de Retz	CWR
Asteraceae	<i>Leucanthemum lacustre</i> (Brot.) Samp.	CWR
Asteraceae	<i>Leuzea longifolia</i> Hoffmanns. et Link	CWR
Asteraceae	<i>Santolina impressa</i> Hoffmanns. et Link	CWR
Asteraceae	<i>Santolina semidentata</i> Hoffmanns. et Link	CWR
Asteraceae	<i>Scorzonera hoffmannseggiana</i> P. Silva	CWR
Asteraceae	<i>Senecio doronicum</i> (L.) L. subsp. <i>lusitanicus</i> Cout.	CWR
Asteraceae	<i>Senecio pyrenaicus</i> L. subsp. <i>caespitosus</i> (Brot.) Franco	CWR
Asteraceae	<i>Serratula acanthocoma</i> Franco	CWR
Asteraceae	<i>Serratula alcalae</i> Cosson subsp. <i>aristata</i> Franco	CWR
Asteraceae	<i>Serratula baetica</i> DC. subsp. <i>lusitanica</i> Cantó	CWR
Asteraceae	<i>Serratula barrelieri</i> Dufour	CWR
Asteraceae	<i>Serratula estremadurensis</i> Franco	CWR
Asteraceae	<i>Serratula flavescens</i> (L.) Poiret in Lam. subsp. <i>flavescens</i>	CWR
Asteraceae	<i>Tanacetum gracilicaule</i> (Rouy) Franco	CWR
Asteraceae	<i>Tanacetum mucronulatum</i> (Hoffmanns. et Link) Heywood	CWR
Asteraceae	<i>Taraxacum algarbiense</i> Van Soest	CWR
Asteraceae	<i>Taraxacum duriense</i> Van Soest	CWR
Asteraceae	<i>Taraxacum lucipedatum</i> Van Soest	CWR
Asteraceae	<i>Taraxacum lusitanicum</i> Van Soest	CWR
Asteraceae	<i>Taraxacum malato-belizii</i> Van Soest	CWR
Asteraceae	<i>Taraxacum pinto-silvae</i> Van Soest	CWR
Asteraceae	<i>Taraxacum pseudomarklundii</i> Van Soest	CWR
Asteraceae	<i>Taraxacum trifforme</i> Van Soest	CWR
Convolvulaceae	<i>Convolvulus fernandesii</i> P. Silva et Teles	CWR
Brassicaceae	<i>Diplotaxis siifolia</i> Kunze subsp. <i>vicentina</i> (Welw. ex Samp.) Mart.	CWR
Brassicaceae	<i>Iberis procumbens</i> Lange subsp. <i>microcarpa</i> Franco et P. Silva	CWR
Euphorbiaceae	<i>Euphorbia paniculata</i> Desf. subsp. <i>monchiquensis</i> (Franco et P. Silva) Vicens, Molero et C. Blanché	CWR
Euphorbiaceae	<i>Euphorbia paniculata</i> Desf. subsp. <i>welwitschii</i> (Boiss. et Reut.) Vicens, Molero et C. Blanché	CWR
Euphorbiaceae	<i>Euphorbia pedroi</i> Molero et Rovira	CWR
Euphorbiaceae	<i>Euphorbia transtagana</i> Boiss.	CWR
Iridaceae	<i>Iris xiphium</i> L. var. <i>lusitanica</i> (Ker-Gawler) Franco	CWR+WHP
Lamiaceae	<i>Ajuga pyramidalis</i> L. subsp. <i>meonantha</i> (Hoffmanns. et Link) R. Fern.	CWR

## Appendix 2 continued

Family	Taxon name	CWR/WHP
Lamiaceae	<i>Lavandula pedunculata</i> (Miller) Cav. subsp. <i>lusitanica</i> (Chaytor) Franco	CWR
Lamiaceae	<i>Lavandula stoechas</i> L. subsp. <i>luisieri</i> (Rozeira) Rozeira	CWR+WHP
Lamiaceae	<i>Sideritis scordioides</i> L. subsp. <i>laniculata</i> (Pérez Lara) Franco	CWR
Lamiaceae	<i>Teucrium algarbiense</i> (Cout.) Cout.	CWR
Lamiaceae	<i>Teucrium salviastrum</i> Schreber	CWR
Lamiaceae	<i>Thymus camphoratus</i> Hoffmanns. et Link	CWR+WHP
Lamiaceae	<i>Thymus capitellatus</i> Hoffmanns. et Link	CWR+WHP
Lamiaceae	<i>Thymus carnosus</i> Boiss.	CWR+WHP
Lamiaceae	<i>Thymus cephalotos</i> L.	CWR+WHP
Lamiaceae	<i>Thymus villosus</i> L. subsp. <i>lusitanicus</i> (Boiss.) Cout.	CWR
Lamiaceae	<i>Thymus villosus</i> L. subsp. <i>villosus</i>	CWR+WHP
Fabaceae	<i>Melilotus segetalis</i> (Brot.) Ser. subsp. <i>fallax</i> Franco	CWR
Fabaceae	<i>Ononis hackelii</i> Lange	CWR
Fabaceae	<i>Trifolium arvense</i> L. var. <i>gracile</i> (Thuill.) DC.	CWR
Fabaceae	<i>Trifolium subterraneum</i> L. subsp. <i>subterraneum</i> var. <i>brachycladum</i> Gibelli et Belli	CWR
Fabaceae	<i>Ulex airensis</i> Espírito Santo et al.	CWR+WHP
Fabaceae	<i>Ulex argenteus</i> Welw. ex Webb. subsp. <i>argenteus</i>	CWR
Fabaceae	<i>Ulex australis</i> Clemente subsp. <i>welwitschianus</i> (Planch.) Espírito Santo et al.	CWR+WHP
Fabaceae	<i>Ulex densus</i> Welw. ex Webb.	CWR+WHP
Fabaceae	<i>Ulex erinaceus</i> Welw. ex Webb.	CWR
Fabaceae	<i>Ulex jussiaei</i> Webb.	CWR
Liliaceae	<i>Allium pruinaum</i> Sprengel var. <i>bulbiferum</i> Cout.	CWR
Liliaceae	<i>Allium schmitzii</i> Cout.	CWR
Liliaceae	<i>Asphodelus bento-rainhae</i> P. Silva	CWR
Liliaceae	<i>Hyacinthoides vicentina</i> (Hoffmanns. et Link) Rothm. subsp. <i>transtagana</i> Franco et Rocha Afonso	CWR
Liliaceae	<i>Hyacinthoides vicentina</i> (Hoffmanns. et Link) Rothm. subsp. <i>vicentina</i>	CWR
Liliaceae	<i>Ornithogalum concinnum</i> (Salisb.) Cout.	CWR
Liliaceae	<i>Scilla ramburei</i> Boiss. subsp. <i>beirana</i> (Samp.) Franco et Rocha Afonso	CWR
Plantaginaceae	<i>Plantago algarbiensis</i> Samp.	CWR
Plantaginaceae	<i>Plantago almogravensis</i> Franco	CWR
Plumbaginaceae	<i>Armeria berlengensis</i> Daveau	CWR
Plumbaginaceae	<i>Armeria eriophylla</i> Willk.	CWR
Plumbaginaceae	<i>Armeria neglecta</i> Girard	CWR
Plumbaginaceae	<i>Armeria pinifolia</i> (Brot.) Hoffmanns. et Link	CWR
Plumbaginaceae	<i>Armeria pseudoarmeria</i> (Murray) Mansf.	CWR
Plumbaginaceae	<i>Armeria rouyana</i> Daveau	CWR
Plumbaginaceae	<i>Armeria sampaioi</i> (Bernis) Nieto Fel.	CWR
Plumbaginaceae	<i>Armeria welwitschii</i> Boiss.	CWR+WHP
Plumbaginaceae	<i>Limonium daveaui</i> Erben.	CWR

## Appendix 2 continued

Family	Taxon name	CWR/WHP
Plumbaginaceae	<i>Limonium laxiusculum</i> Franco	CWR
Plumbaginaceae	<i>Limonium multiflorum</i> Erben.	CWR
Plumbaginaceae	<i>Limonium plurisquamatum</i> Erben.	CWR
Poaceae	<i>Agrostis litigans</i> Steud.	CWR
Poaceae	<i>Dactylis glomerata</i> L. subsp. <i>lusitanica</i> Stebbins et Zohary	CWR
Poaceae	<i>Dactylis marina</i> Borrill	CWR
Poaceae	<i>Deschampsia stricta</i> Hackel	CWR
Poaceae	<i>Festuca brigantina</i> (Markgr.-Dannenb.) Markgr.-Dannenb.	CWR
Poaceae	<i>Festuca duriotagana</i> Franco et Rocha Afonso var. <i>barbata</i> Franco et Rocha Afonso	CWR
Poaceae	<i>Festuca duriotagana</i> Franco et Rocha Afonso var. <i>duriotagana</i>	CWR
Poaceae	<i>Festuca henriquesii</i> Hackel	CWR
Poaceae	<i>Festuca indigesta</i> Boiss. subsp. <i>indigesta</i>	CWR
Poaceae	<i>Festuca petraea</i> Seub.	CWR
Poaceae	<i>Holcus annuus</i> C. A. Meyer subsp. <i>duriensis</i> (P. Silva) Franco et Rocha Afonso	CWR
Poaceae	<i>Koeleria caudata</i> (Link) Steudel	CWR
Ranunculaceae	<i>Ranunculus henriquesii</i> Freyn	CWR
Rosaceae	<i>Aphanes lusitanica</i> Frost-Olsen	CWR
Rubiaceae	<i>Galium corrudifolium</i> Vill. subsp. <i>falcatum</i> (Willk. et Costa) Franco	CWR
Rubiaceae	<i>Galium palustre</i> L. subsp. <i>tetraploideum</i> A. R. Clapham	CWR
Saxifragaceae	<i>Saxifraga cintrana</i> Kuzinsky ex Willk.	CWR
Scrophulariaceae	<i>Antirrhinum majus</i> L. subsp. <i>linkianum</i> (Boiss. et Reut.) Rothm.	CWR
Scrophulariaceae	<i>Digitalis purpurea</i> L. subsp. <i>heywoodii</i> P. et M. Silva	CWR+WHP
Scrophulariaceae	<i>Digitalis purpurea</i> L. subsp. <i>mariana</i> (Boiss.) Rivas Goday	CWR
Scrophulariaceae	<i>Euphrasia mendoncae</i> Samp.	CWR+WHP
Scrophulariaceae	<i>Linaria algarviana</i> Chav.	CWR
Scrophulariaceae	<i>Linaria ficalhoana</i> Rouy	CWR
Scrophulariaceae	<i>Linaria lamarckii</i> Rouy	CWR
Scrophulariaceae	<i>Linaria ricardoii</i> Cout.	CWR
Scrophulariaceae	<i>Linaria sparteae</i> (L.) Willd. subsp. <i>sparteae</i>	CWR
Scrophulariaceae	<i>Linaria sparteae</i> (L.) Willd. subsp. <i>virgatula</i> (Brot.) Franco	CWR
Scrophulariaceae	<i>Scrophularia grandiflora</i> DC. subsp. <i>grandiflora</i>	CWR
Scrophulariaceae	<i>Scrophularia herminii</i> Hoffmanns. et Link	CWR
Scrophulariaceae	<i>Scrophularia schmitzii</i> Rouy	CWR
Scrophulariaceae	<i>Scrophularia schousboei</i> Lange in Willk. et Lange subsp. <i>montana</i> Franco	CWR
Scrophulariaceae	<i>Scrophularia schousboei</i> Lange in Willk. et Lange subsp. <i>schousboei</i>	CWR
Scrophulariaceae	<i>Scrophularia scorodonia</i> L. subsp. <i>multiflora</i> (Lange) Franco	CWR
Scrophulariaceae	<i>Verbascum litigiosum</i> Samp.	CWR
Valerianaceae	<i>Valerianella lusitanica</i> Font Quer	CWR
Valerianaceae	<i>Valerianella platiloba</i> Dufresne	CWR

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