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IBERIAN ENDEMIC *APIACEAE*: A REASSESSMENT FOR CONSERVATION PURPOSES IN PORTUGAL

Apiaceae *endémicas ibéricas: una reevaluación de las propuestas de conservación en Portugal*

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RESUMEN: Este trabajo es parte de un proyecto cuyo objetivo es la conservación *in vitro* y *ex situ* de especies de la familia *Apiaceae* endémicas de Portugal y la caracterización bioquímica de sus aceites esenciales. Hay 14 *taxa* endémicos descritos en Portugal, pero el equipo de este proyecto no ha encontrado *Bunium macuca* subsp. *macuca* en las 152 salidas de campo realizadas en 49 sitios diferentes durante 6 años (2005-2010). Por tanto, este estudio incluye 13 especies, de las cuales *Angelica pachycarpa, Daucus carota* subsp. *halophilus, Distbicoselinum tenuifolium* y *Seseli montanum* subsp. *peixotoanum* fueron consideradas las especies prioritarias para su conservación ya que son las más vulnerables en Portugal. Se ha conseguido la conservación *ex situ* de todos los *taxa* portugueses en el COI Herbaria y en el Jardín Botánico de Coímbra (semillas y colección de plantas vivas). Las especies más vulnerables también se han propagado y mantenido *in vitro*.

Este trabajo presenta la distribución geográfica actualizada de 13 especies de la familia *Apiaceae* endémicas de Portugal, las características taxonómicas más importantes para su identificación y la caracterización de los hábitats que ocupan.

Se presentan también algunas indicaciones específicas para *Angelica, Bunium*, *Conopodium*, *Daucus* y *Eryngium*, así como dos claves taxonómicas para la identificación de las cuatro subespecies nativas de *Daucus carota* y las dos subespecies de *Eryngium duriaei*. El objetivo final de estos resultados es reunir datos taxonómicos, ambientales y biotecnológicos para ayudar en la conservación de estos *taxa* con importancia biológica y económica.

Palabras clave: Plantas aromáticas, ancestros silvestres, taxones amenazados, claves taxonómicas.

ABSTRACT: This work is part of a project on the *in vitro* and *ex situ* conservation of the Iberian endemic Apiaceae from Portugal and the biochemical characterization of their essential oils. Fourteen Iberian endemic *taxa* belonging to eleven genera are ascribed to Portugal. As a result of 152 field trips to 49 different locations (150 numbers collected) during six years (2005 to 2010), *Bunium macuca* subsp. *macuca* was not find yet. Thus, only 13 *taxa* could be studied from which *Angelica pachycarpa, Daucus carota* subsp. *halophilus, Distbicoselinum tenuifolium* and *Seseli montanum* subsp. *peixotoanum* were considered the priority *taxa* for conservation, as they are the four more vulnerable *taxa* in Portugal. The *ex situ* conservation of every Portuguese *taxa* in the COI Herbaria and in the Botanic Garden of Coimbra (seedbank-*Index seminum* and living collections) was acheived, being the more vulnerable also propagated and maintained through *in vitro* culture methods.

An updated geographical distribution of the 13 Iberian endemic Apiaceae in Portugal, as well as the more indicated taxomic features to distinguish them is presented. A characterization of the habitats is also provided. Specific indications are expresed for some *taxa*, namely *Angelica, Bunium*, *Conopodium*, *Daucus* and *Eryngium*. Two taxonomic keys were described for the identification of the four native subspecies of *Daucus carota* and the two subspecies of *Eryngium duriaei*. These outcomes have the main purpose to gather taxonomic, environmental and biotechnological data to help the conservation of these important *taxa* both from a biological and economic perspective.

Keywords: Aromatic plants, crop wild relative, endangered taxa, taxonomic keys.

INTRODUCTION

The increasing threats to the natural ecosystems and to the plant diversity is partly due to the abusive harvest of plants for medicinal purposes and industrial uses. Moreover, the possible future impacts related with climatic changes will bring on other negative environmental consequences. Attempts to preserve the genetic patrimony, mainly the one of rare species, crops and the crop wild related (CWR) species is of outmost importance (CBD, 2002; MAXTED & DULLOO, 2008; SHARROCK, 2006). In this context, it is important to develop both *ex situ* programs and *in vitro*

micropropagation techniques which allow genotype conservation and also a rapid multiplication of target-plants (EKIERT, 2000).

Botanic Gardens and associated research units are qualified institutions for plant preservation and germplasm maintenance, such as seed banks, cryobanks or *in vitro* collections. Plant conservation is particularly pertinent for endangered species and endemic plants, usually living in small populations and often surviving in special and restricted habitats (ALMEIDA *et al*., 2007; HAWKINS, 2008).

The Botanic Garden of the University of Coimbra, as a Botanic Garden Conservation International (BGCI) member, has been involved in some of these actions and this project goal is the *in vitro* and *ex situ* conservation of the Iberian endemic *Apiaceae* in Portugal and the chemical and biological characterization of their essential oils.

In the context of Plant Biotechnology several micropropagation tecnhiques have been applied to the *in vitro* conservation of threatened species as well as to the study of secondary metabolites (BACCHETTA, 2008; CANHOTO, 2010; TAVARES *et al*., 2008b, 2010c).

The Iberian Peninsula is very rich in endemic species, many of them belonging to the *Apiaceae* family with recognized aromatic and medicinal potential for industrial purposes (medicinal, pharmaceutical, culinary), due to their specific secondary metabolites (EKIERT, 2000; GIMÉNEZ *et al*., 2004; TAVARES *et al*., 2008b, 2010c). Some of these species are also CRWs (MAXTED & DULLOO, 2008), since they are phylogenetically similar to cultivated plants. Thus, CWRs are a source of genetic diversity that has been explored. For this particular purpose the more important Iberian endemic *Apiaceae* in Portugal is the carrot subspecies *Daucus carota* subsp. *halophilus* (TAVARES *et al.,* 2008a, 2010a).

The Iberian endemic *Apiaceae* from Portugal belong to eleven genera *(Angelica*, *Bunium*, *Conopodium*, *Daucus*, *Distichoselinum*, *Eryngium*, *Ferula*, *Ferulago*, *Laserpitium*, *Seseli* and *Thapsia)* and 14 *taxa* are referred (Table 1; Figs. 1-15), from which one subspecies is exclusively Portuguese *(Daucus carota* subsp. *halophilus).* In this work the study, conservation and new uses of these *taxa* was evaluated. The studies have dealt with the aromatic-medicinal properties of unexploited essential oils of uncommon or rare (endemic) Portuguese *Apiaceae* (TAVARES *et al*., 2008a, 2010b, 2010c; GONÇALVES *et al*., 2012). Through the application of e*x situ* and *in vitro* propagation techniques some of the *taxa* analysed in this work have already been propagated *in vitro* and preserved in the seed bank of the Botanic Garden of Coimbra (ALMEIDA *et al*., 2007; TAVARES *et al*., 2009, 2010a, 2011b).

For any conservation program a first crucial step is unequivocally the identification of the different *taxa*. Moreover, an easy, clear and concise caracterization of the Iberian endemic *Apiaceae* occuring in Portugal as well as a revision of their geographical distribution and the characterization of their habitats (TAVARES *et al*., 2008b) is also necessary, goal that we intend to achieve with this work.

MATERIAL AND METHODS

1. ABREVIATIONS

To simplify the text, the following abbreviations are used:

BGUC - Botanic Garden of the University of Coimbra.

Herbaria

COA - Jardín Botánico de Córdoba.
COI - Instituto Botânico da Universidade de Coimbra.
LISE - Estação Agronómica Nacional - Oeiras.
LISI - Instituto Superior de Agronomia de Lisboa.
MA - Real Jardín Botánico de Madrid, CSIC.
MGC - Facultad de Ciencias. Universidad de Málaga.
PO - Faculdade de Ciências da Universidade do Porto.

Iberian provinces (Portugal) (CASTROVIEJO *et al*., 2003)

AAl - Alto Alentejo.
Ag - Algarve.
BA - Beira Alta.
BAl - Baixo Alentejo.
BB - Beira Baixa.
BL - Beira Litoral.
DL - Douro Litoral.
E - Estremadura.
Mi - Minho.
R - Ribatejo.
TM - Trás-os-Montes e Alto Douro.
LPBUC - Laboratory of Plant Biotechnology of the University of Coimbra.

2. IDENTIFICATION, LOCALIZATION AND CHARACTERIZATION OF THE TARGET-SPECIES

For the identification, phenology and geographic localization of the *taxa*, some Floras were used (AMARAL FRANCO, 1974; CASTROVIEJO *et al.*, 2003; PEREIRA COUTINHO, 1939; SAMPAIO, 1988; TUTIN *et al*., 1968) and several taxonomic publications (AGUIAR, 2001; ALMEIDA, 2005; ALMEIDA, 2006; ALMEIDA, 2009a, 2009b; AMADO, 2007; CONSELHO DA EUROPA, 1977, 1983; GÓMEZ-CAMPO *et al*., 1987; HONRADO, 2003; ICN, 2007; LOPES, 2001; MARIZ, 1896; MATEO & UDIAS, 2000; PINTO-GOMES, 1998; PINTO-GOMES and PAIVA-FERREIRA, 2005; PINTO-GOMES *et al*., 2008; PUJADAS SALVÁ, 2003a; PUJADAS SALVÁ, 2000a, 2000b, 2003b; QUEIROGA *et al*., 2008; RIBEIRO, 2006; RIVAS-MARTÍNEZ *et al.*, 2002; SILVEIRA, 2001, 2007; TAULEIGNE GOMES *et al*., 2004; electronic documents in web-sites), as well as the study of the voucher

material of some Herbaria (COA, COI, LISE, LISI, MA, MGC, PO). Field growing plants were also analysed *in situ* and voucher materials were made and deposited at the Herbarium of the University of Coimbra (COI). The field trips were also used for collecting seeds and living material for the experiments related with *in vitro* propagation and essential oil characterization.

3. Criteria for target-species herborization

For the conservation status of the referred 14 *taxa* the following documents were consulted: UICN (Gómez-Campos *et al*., 1987); ICNB (Nature and Biodiversity Conservation Institute) Dec.-Lei n.º 140/99 de 24/04, after Dec.-Lei n49/2005, 24/2; documents of the European Union (ZPE and SIC-Rede Natura, 2000; http://portal.icnb.pt/ICNPortal/vPT2007-"Directiva Hábitats"; Amado *et al*., 2007; Queiroga *et al*., 2008). Based on these documents it could be concluded that only *Angelica pachycarpa* can be considered a rare species (Queiroga *et al*., 2008).

According to *Flora Iberica* (Castroviejo *et al*., 2003) priority criteria for collecting material were established. Thus, a three type conservation priority criteria was established: RED - priority species, present only in one Portuguese province or exclusively in Portugal (5 *taxa*); YELLOW - present in 2-4 Portuguese provinces (5 *taxa*); GREEN - present in 5 or more Portuguese provinces: (4 *taxa*). The distribution of the different *taxa* based on these criteria is displayed in Table 1.

RESULTS

1. Field trips

Following the defined priority criteria it has been possible to identify, localize and harvest plants and/or seeds of 13 endemic Iberian *Apiaceae* in Portugal (Figs. 1-15; annexe I). Plant gathering was made according to very restrict criteria in order to avoid population damage.

In this study (2005-2010) 152 field trips to 49 different locations were made, from North to the South of continental Portugal, resulting in more than 150 voucher specimens (see annexe 1). It must be emphasized that for the study of *Daucus carota* subsp. *halophilus* and the other 4 subspecies *(Daucus carota* subsp *carota, Daucus carota* subsp *sativus, Daucus carota* subsp *maximus, Daucus carota* subsp. *gummifer)* 71 field trips were made to 19 different locations. These were not indicated in Table 1, that refers only to the endemic *taxa* collected in 36 different sites in 121 field trips, according to the defined conservation priority criteria.

Table 1. Iberian endemic *Apiaceae* in Portugal: geographical distribution conservation priority criteria, localities and number of field trips (2005-2010)

Taxa	Provinces	Conservation priority criteria	Locations	N.º of field trips
1. Eryngium galioides	Ag AAl BA BAl BB (TM).	GREEN	Nave do Barão	1
2.1. Eryngium duriaei subsp. *duriaei*	BA BL Mi TM.	YELLOW	Serra da Estrela	2
2.2. Eryngium duriaei subsp. *juresianum*	Mi BL DL.	YELLOW	Serra da Freita Açor Gerês Mata da Margaraça	1 4 2 1
3. Daucus carota subsp. *halophilus*	Costa SW, Ag BAl E.	RED	Cabo S. Vicente Arrifana Cabo Sardão Cabo Carvoeiro Cabo da Roca Cabo Espichel	10 5 5 4 3 3
4. Bunium macuca subsp. *macuca*	AAl.	RED	Not found	12
5. Conopodium subcarneum	BA (BB) BL(E) TM.	YELLOW	Serra da Arada Serra da Nogueira, Bragança	1 1
6. Conopodium majus subsp. *marizianum*	AAl Ag BA BAl BB BL DL E Mi (R) TM.	GREEN	Tabuaço Serra da Freita Lousã Montemuro	1 1 2 2
7. Seseli montanum subsp. *peixotoanum*	TM.	RED	Alimonde Samil	5 5
8. Angelica major	BA BB Mi TM.	YELLOW	Serra da Estrela	4
9. Angelica pachycarpa	Berlenga Islands-E.	RED	Berlenga	4
10. Ferula communis subsp. *catalaunica*	AAl Ag BA BAl BB BL E R TM.	GREEN	Guarda Évora Loulé Óbidos	2 2 1 2
11. Ferulago capillaris	BA Mi TM.	YELOW	Celorico da Beira Guarda Gerês	1 3 2
12. Distichoselinum tenuifolium	Ag.	RED	Moncarapacho Espargal Burgau	7 1 2
13. Laserpitium eliasii subsp. *thalictrifolium*	Mi TM (BA).	YELLOW	Gerês Bragança	3 1
14. Thapsia minor	AAl Ag BA BAl BB BL DL E Mi TM.	GREEN	Mucelão Queimadela Piódão, Açor	1 3 1

The species *Bunium macuca* subsp. *macuca* previously referred as present in Portugal (CASTROVIEJO *et al.*, 2003) could not be found. After consulting several Portuguese botanists and collectors it can be assumed that this endemic Iberian subspecies might be extinct in Portugal.

2. DESCRIPTIONS, HABITATS AND DISTRIBUTIONS

Following the information in Table 1, the target-plants are described in the following sections and the provinces where they were collected are indicated in **bold** (voucher specimens are referred in annexe I):

1. ***Eryngium galioides*** Lam.

Annual, rarely biennial herb. Stems 3-15(-30) cm tall, procumbent to erect. Basal leaves 2-8 x 0.2-1 cm, oblanceolate to linear-lanceolate, dentate to incise-serrate. Capitula sessile, 0.5-1 cm in diam., subglobose. Fruit ellipsoid.

Boggy or seasonally wet places, usually sandy; 250-470 m. VI-IX. AAl, **Ag**, BA, BAl, BB (TM).

Figure 1. *Eryngium galioides* Lam. Loulé, Nave do Barão (Ag).

2. ***Eryngium duriaei*** J. Gay ex Boiss.

Perennial herb. Stems (20-)30-150 cm tall, erect. Basal leaves 8-25(-45) x 2-5(-7) cm, narrow linear-oblanceolate, oblong-obovate to spathulate, denticulate. Capitula pedunculate (peduncle 3-5 cm long), the terminal one 4-8(-10) x 1.5-3 cm, cylindric-ellipsoid, the lateral ones shorter and ellipsoid. Fruit 3-4 x 2.5-3 mm.

The species present some morphological variation, mainly in the basal leaves. Thus, two subspecies are considered which can be distinguished with the help of the following key:

– Herb up to 100 cm tall; capitula up to 3(-3.5) cm long, cylindric-ellipsoid to ellipsoid; bracts up to 3.5 cm long, strongly cuspidate; basal leaves petiolate, narrow linear-oblanceolate to oblong-obovate, pinnatifid-dentate, undulate; cauline ones shortly petiolate to sessile……..... subsp. ***duriaei***
– Herb up to 180 cm tall; capitula up to 8 cm long, oblong-cylindric to cylindric-ellipsoid; bracts up to 2.5 cm long, softly cuspidate; basal leaves almost sessile, spathulate and flat, denticulate to incise-dentate, cauline ones stem-clasping……..... subsp. ***juresianum***

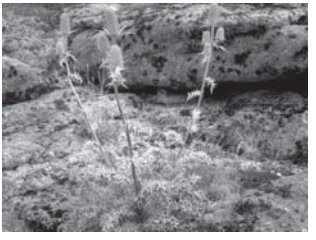

Figure 2. *Eryngium duriaei* J. Gay ex Boiss. subsp. *duriaei*. Cântaro Raso, Serra da Estrela (BA).

Eryngium duriaei J. Gay ex Boiss. subsp. ***duriaei***

Granitic rock fissures and slopes. 1700 m. VII-IX. **BA.**

Eryngium duriaei J. Gay ex Boiss. subsp. ***juresianum*** (M. Laínz) M. Laínz

Edges of oak forests, and humid slopes, mainly on schist. 700-1000 m. VII-X. **BL**, **DL**, **Mi**, TM.

Figure 3. *Eryngium duriaei* J. Gay ex Boiss. subsp. *juresianum* (M. Laínz) M. Laínz. Colcurinho, Serra do Açor (BL).

3. ***Daucus carota*** L.

Biennial to perennial herb. Stems (3-)10-170 (-200) cm tall, procumbent to erect, glabrous to hispid. Basal leaves (1-)2-4(-5)-pinnatisect, rarely less divided. Umbels concave, flat or convex, with a variable number of rays, pedunculate, rarely subsessile. Fruit (1.5-)2-4 mm long, ellipsoid to subglobose, with the spines on the secondary ridges shorter than the width of the mericarps.

Meadows, open woodlands, rocky and coast crags, sandy beaches and ruderal; 0-1800 m. III-IX.

All provinces.

Species extremely polymorphic divided into several subspecies, of which the following 5 appear to deserve recognition in Portugal: subsp. ***carota***; subsp. ***gummifer***; subsp. ***halophilus***; subsp. ***maximus*** and subsp. ***sativus***, this one cultivated.

They can be identified by the following key:

1. Last segments of the bracts sublinear to thread-like, rays of the flowering umbels arched-convergent; secondary ridges of the mericarp with slender spines, scarcely dilated at the base..... 2
1. Last segments of the bracts ovate, lanceolate to linear-lanceolate; rays of the flowering umbels ± straight to rather arched-convergent; secondary ridges of the mericarp with thick spines dilated and joined at the base 4
2. Cultivated plants, with a turnip-shaped taproot, fleshy, usually orange or yellowish to purplish, rarely whitish ..... subsp. ***sativus***
2. Wild plants, with a cylindrical taproot, fibrous, whitish..... 3
3. Flowering umbels (1.5-)3-7(-11) cm in diam.; bracts 7-9, as long as or almost as long as the ray..... subsp. ***carota***
3. Flowering umbels 12-23 cm in diam.; bracts 10-13, shorter than the rays ..... subsp. ***maximus***
4. Segments of the bracts linear-lanceolate to linear, slightly mucronate; secondary ridges of the mericarp with thick, antrorse or patent spines..... subsp. ***gummifer***
4. Segments of the bracts ovate to ovate-elliptic, shortly mucronate; secondary ridges of the mericarp with slender, patent spines ..... subsp. ***halophilus***

Daucus carota L. subsp. ***carota***
Meadows, open woodlands. 0-1800 m. IV-X. All provinces.

Daucus carota L. subsp. ***gummifer*** (Syme) Hook.f. & G. Martens
Rocky and coast crags, sandy soil. 0-50 m. IV-IX. (BAl) **BL** DL **E.**

Daucus carota subsp. ***halophilus*** (Brot.) A. Pujadas
Rocky and coast crags, sandy beaches and fossil dunes. 10-50 m. IV-VI. **Ag, Bal, E.**

Daucus carota L. subsp. ***maximus*** (Desf.) Ball
Open woodlands. 0-1400 m. IV-VIII. **AAl**; Ag; (BAl).

Daucus carota L. subsp. ***sativus*** (Hoffm.) Schübl. & G. Martens
Cultivated. 0-1500 m. IV-VI.

4. ***Bunium macuca*** **Boiss. subsp. *macuca***

Perennial herb. Stems 5-35 cm tall, slender, branched, with the branches in acute angle. Basal leaves long-petiolate, deltoid, 2-3-pinnatisect, segments linear to spathulate, mucronate. Umbels (1-)2-6 cm in diam., with 5-8(-10) rays, 15-35(-45) mm long; peduncles 2-8 cm long. Fruit 2-3 mm long.

Forest fringes and rocky or stony rugged grounds; 250-470 m. IV-VIII. E.

G. Mateo and S. López Udias (CASTROVIEJO, *Flora Ibérica* X: 66. 2003) placed the occurrence of this *taxon* in Alto Alentejo (AAl) province. The only Herbaria specimen (COI; see Fig. 4) that we have consulted in COI was collected near Setúbal, which is in the Estremadura province (E) and not in AAl as previously indicated. However, attempts to find this *taxon* both in Setúbal and in other places in Estremadura or in the Alto Alentejo province were unsuccessful.

5. ***Conopodium subcarneum*** (Boiss. & Reut.) Boiss.

Perennial herb. Stems (10-)20-60(-75) cm tall. Basal leaves long-petiolate, 3-pinnatisect, segments pinnate, mucronate, glabrous. Sepal-teeth almost inconspicuous. Petals 1-1,5 mm, usually emarginated or no, white to pinkish. Fruit 2.8-4 mm long.

Bushwoods, pasturelands, rocky and sandy places; 200-1900 m. V-IX. **BA**, (BB), BL, (E), **TM**.

6. ***Conopodium majus*** (Gouan) Loret subsp. ***marizianum*** (Samp.) López-Udias & Mateo

Perennial herb, with a subglobose tuber, 1.3-2.5 cm in diam. Stems 15-60 cm tall. Basal leaves long-petiolate, 2(-3)-pinnatisect, segments 3-6 lobate, ovate to suborbicular-kidney-shaped, hairy, at least in the rachis. Umbels 4-7 cm in diam., with 6-14 rays, 2-4.5 cm long; peduncles 1,5-6 cm long, glabrous. Fruit 3-5 mm long.

Bushwoods, rocky and sandy places, usually granitic; 200-1900 m. IV-VIII. AAl, Ag, **BA**, BAl, BB, **BL**, E, Mi, (R), **TM**.

Figure 4. *Daucus carota subsp. halophilus* (Brot.) A- Pujadas. Cabo S. Vicente (Ag). Plant.

Figure 6. Conopodium subcarneum (Boiss. & Reut.) Boiss. Aldeia da Pena, S. Pedro do Sul, Serra da Arada, (BA). Umbels.

Figure 5. *Bunium macuca subsp. macuca*. Specimen of the Herbarium of Coimbra.

Figure 7. *Conopodium majus* (Gouan) Loret subsp. marizianum (Samp.) López Udias & Mateo. Montemuro (DL). A. C. Tavares, 46 (COI).

7. ***Seseli montanum*** L. subsp. ***peixotoanum*** (Samp.) M. Laínz

Perennial herb, with a ± vertical stock. Stems (10-)35-70(-80) cm tall, erect. Basal leaves petiolate, 1.8-12 x 0.8-3 cm, 2-pinnatisect, segments linear, glabrous or pappilose. Umbels terminal with 5-9 rays, 3-10 mm long; rays of the secondary umbels 0.5-1(-1.5) mm long. Fruit 2-3.5(-4.5) x 1-1.5 mm.

Bushwoods, ultrabasic soils; 750 m. VIII-X. **TM**.

8. ***Angelica major*** Lag.

Biennial, rarely perennial herb. Stems 40-120 cm tall. Basal leaves 3-pinnatisect, lateral lobes ovate, sessile, dentate or crenate-mucronate. Petals white to yellowish. Fruit 4-9 x 5.5-6.5 mm. Rocky-heathlands open bushlands; siliceous soils; 650-1900 m. VI-IX. **BA**, BB, Mi, TM.

9. ***Angelica pachycarpa*** **Lange**

Robust perennial herb, fleshy. Stems 100 cm tall. Umbels on short, stout peduncles, with 15-25 robust rays, usually pubescent. Fruit 4.5-11 x 3.5-9 mm.

Maritime rocky places; 0-50 m. V-VI. **E**.

10. ***Ferula communis*** L. subsp. ***catalaunica*** (Pau ex Vicioso) Sánchez-Cuxart & Bernal

Robust, perennial herb. Stems (100-)160-250(-330) cm tall. Leaves with conspicuous sheathing. Terminal umbels sessile or with a short peduncle, 5-35 mm long, with (6-)12-26(-50) rays, (13-)22-45(-120) mm long. Fruit strongly compressed dorsally, obovate to elliptical.

Bushwoods, grasslands, along the roads, sometimes cultivated; 0-1600 m. V-VII. AAl, **Ag**, **BA**, BAl, BB, BL, **E**, R, TM.

11. ***Ferulago capillaris*** (Link ex Spreng.) Cout.

Perennial herb. Stems 60-160 cm tall, erect. Basal leaves up to 60 x 35 cm, 4-6-pinnatisect, segments linear or linear-lanceolate, mucronulate. Terminal umbels hermaphrodite, lateral ones, when present, unessexuad; main umbel pedunculate. Fruit 10-19 x 5-9,5 mm.

Disturbed bushwoods.

12. ***Distichoselinum tenuifolium*** (Lag.) García-Martín & Silvestre

Perennial herb, glabrous. Stems up to 130 cm tall, striate, branched above. Basal leaves distichous, up 55 cm long, (4-)5-pinnatisect, ovate, thick, divisions often whorled, lobes linear to linear-lanceolate, mucronulate. Sepal-teeth 0.5-0.8 x 0.3-0.7 mm. Petals ovate, yellow. Fruit 8-18 x 2-4 mm (without wings).

Disturbed bushwoods, slopes and rocky places, in limestone; 0-1300 m. V-VIII. **Ag**.

Figure 8. *Seseli montanum L. subsp. peixotoanum* (Samp.) M. Laínz. Samil, Bragança (TM). Plant.

Figure 9. *Angelica major* Lag., Senhora da Pedra, Serra da Estrela (BA). Umbels.

Figure 10. *Angelica pachycarpa* Lange. Ilha Berlenga (E). Umbels not matured.

Figure 11. *Ferula communis subsp. catalaunica* (Pau ex C. Vicioso). Óbidos (BL). Umbels.

Figure 12. *Ferulago capillaris* (Link ex Spreng.) Cout. Dry-bed of Homem river, Serra do Gerês (Mi). Umbels. Plant.

13. ***Laserpitium eliasii*** Sennen & Pau subsp. ***thalictrifolium*** (Samp.) P. Monts.

Robust, perennial herb. Basal leaves 3(-4)-pinnatisect, segments 3-lobed. Main umbel with 12-20(-30) rays, (3-)4-6(-9) cm long. Fruit (6-)7-8(-11) mm long.

Edges of oak forests, siliceous soils; (400-)600-1100(-1500) m. VI-IX. (BA), **Mi**, **TM**.

14. ***Thapsia minor*** **Hoffmanns. & Link**

Perennial herb, glabrous. Basal leaves 2-3-pinnatisect, Umbels with 4-10(-12) rays, 4-9 cm long, subequal or unequal. Sepal-teeth 5, too small. Petals obovate, yellow. Fruit 9-12 x 6-10 mm.

Pinewood, holm oakwood, cork oakwood, usually in acid soils; 190-1300 m. IV-VII. AAl, Ag, **BA**, BAl, BB, **BL**, DL, E, Mi, TM.

Figure 13. *Distichoselinum tenuifolium* (Lag.) García Martín & Silvestre. Moncarapacho, Olhão (Ag).

Figure 14. *Laserpitium eliasii subsp. thalictrifolium* (Samp.) P. Monts. Dry-bed of Homem river, Serra do Gerês (Mi). Umbel and leaves.

Figure 15. *Thapsia minor* Hoffmanns. & Link. Queimadela (DL). Umbel.

3. CONSERVATION

The location and *ex situ* conservation of the Iberian endemic *Apiaceae* in Portugal was achieved and it was possible to maintain eleven *taxa* at the Coimbra Botanic Garden seed bank. The respective *Index Seminum* code number is presented in Table 2 and the seeds are available on-line (http//www.uc.pt/jardimbotanico/indexseminum).

Table 2. Iberian endemic *Apiaceae* in Portugal: *ex situ (Index seminum*-code number) and *in vitro* conservation

TAXA	YEAR OF INCLUSION IN THE SEED BANK	SEED CODE NUMBER	*EX SITU* AND *IN VITRO* CONSERVATION	VOUCHER SPECIMEN
1. Eryngium galioides	Not included	Seeds not ripened	-	COI
2. Eryngium duriaei	Before and after 2005	1882 PT0COI	BGUC	COI
3. Daucus carota subsp. *halophilus*	2005˙	1754 PT0COI	BGUC / LPBUC	COI
4. Bunium macuca subsp. *macuca*	Not localized in Portugal	Possible exctinted	-	-
5. Conopodium subcarneum	Not included	Seeds not ripened	-	COI
6. Conopodium majus subsp. *marizianum*	Before and after 2005	1266 PT0COI	BGUC	COI
7. Seseli montanum subsp. *peixotoanum*	2008*	2100 PT0COI	BGUC / LPBUC	COI
8. Angelica major	Before and after 2005	1252 PT0COI	BGUC	COI
9. Angelica pachycarpa	2006*	2059PT0COI	BGUC / LPBUC	COI
10. Ferula communis subsp. *catalaunica*	Before and after 2005	1277 PT0COI	BGUC	COI
11. Ferulago capillaris	Before and after 2005	1756 PT0COI	BGUC	COI
12. Distichoselinum tenuifolium	2006*	2081 PT0COI	BGUC / LPBUC	COI
13. Laserpitium eliasii subsp. *thalictrifolium*	2010*	2121 PT0COI	BGUC	COI
14. Thapsia minor	2009*	2104 PT0COI	BGUC	COI

The seed bank collection of BGUC was enriched with the integration of six Iberian endemic *Apiaceae*, for the first time in almost 150 years of activity, namely:

Angelica pachycarpa, Daucus carota subsp. *halophilus, Distichoselinum tenuifolium, Seseli montanum* subsp. *peixotoanum, Laserpitium eliasii* subsp. *thalictrifolium* and *Thapsia minor*. To enhanced the *ex situ* conservation possibilities, samples of every *taxa* have been sent annually to the Millenium Seed Bank (London, UK) and to the Portuguese Germplasm Bank (Braga, Portugal).

The *ex situ* conservation was also achieved by the cultivation of the plants in the BGUC living collections, with voucher species integrated in the Herbarium of Coimbra (see annexe I), being the four more vulnerable *taxa* propagated and kept *in vitro* (TAVARES *et al*., 2009, 2009-2010, 2010a, 2011b, 2011c), as shown in Table 2.

DISCUSSION AND CONCLUSIONS

The consultation of Herbarium material and the study of published literature are obligatory tasks for the identification, recognition of the geographical localization, as well as the phenologic and the habitat characterisation of plants specimens. This first step was even obligatory to certify all the subsequent research work. When working with endemic rare species this issue is even more relevant, since plants are restricted to very specific and usually limited geographical locations.

The more recent revision concerning the Iberian *Apiaceae* is that of the Flora Iberica (CASTROVIEJO *et al*., 2003, vol. 10), which makes this work a reference for those interested in this subject. After six years of work (2005 to 2010), excluding *Bunium macuca* subsp. *macuca*, it was possible to localize all the other 13 Iberian endemic Apiaceae, in 152 field trips to 49 different localities, from North to South of Portugal, which produced more tan 150 voucher specimens.

The information obtained indicated that the Iberian endemic *Apiaceae* is a group of plants displaying a wide edafo-climatic range, comprising species with broad habitats variability, from the ultrabasic soils of Trás-os-Montes e Alto Douro *(Seseli montanum* subsp. *peixotoanum)* (AGUIAR, 2001) to the calcareous soils of Algarve («barrocal algarvio»- *Distichoselinum tenuifolium*) (PINTO-GOMES, 2005).

After an accurated analysis of specimens from Spain and Portugal Herbaria material, the only localization indicated for *Bunium macuca* subsp. *macuca* refers to Setúbal, 1901- Herbario COI (Fig. 5), which is located in the province of Estremadura instead of Alto Alentejo, as misinterpreted in Flora Iberica. Even so, the plant could not be found neither in Setúbal area nor in Alto Alentejo. Moreover, it was not possible to find any references to this species in specialized publications, namely the works of several Portuguese taxonomists (ALMEIDA, 2009a; AGUIAR, 2001; HONRADO, 2003; LOPES, 2001; PINTO-GOMES, 2008; RIBEIRO, 2006; SILVEIRA, 2001). Based on these data it might be appropriate to consider that this species is actually extinct in Portugal.

Both *Conopodium subcarneum* and *Eryngium galioides* have been considered as quite rare *taxa* in Portugal (AGUIAR, 2001; PINTO-GOMES, 2008). Our studies confirm this idea since we could localized the two species only in the provinces of Beira Alta and Algarve, respectivelly. *Eryngium galioides,* in particular, is considered a very rare endemism by Portuguese specialists, and the results of this work confirm this information, since the *taxon* was found in one very specific habitat: Nave do Barão, Algarve.

On the contrary, and in spite of the descriptions included in *Flora Iberica*, *Eryngium duriaei* could be observed in the region of Douro Litoral (Frecha das Misarela, Serra da Freita). The two subspecies referred in *Flora Iberica* could be collected based on their different morphological characteristics already described. Phytochemical studies and DNA molecular markers for these two subspecies are being carried out to clarify their genetic and quimiotaxonomic background (TAVARES *et al*., 2011a).

Also, for *Daucus carota* subspecies these studies will be crucial since there is a great morphological variability between the 4 native subspecies, which makes very difficult to identify them beyond doubt.

Based in our field work and on a better identification of the differences between these *taxa*, two taxonomic keys were developed: one for the distintion of the 4 native subspecies of *Daucus carota* and the other for the 2 subspecies of *Eryngium duriaei*.

The more vulnerable species is *Angelica pachycarpa* since it only occurs in the Berlenga Islands (QUEIROGA *et al*., 2008). Some results concerning the micropropagation of this species have already been published (TAVARES *et al*., 2009-2010). The excessive sea-gull population of the island has difficulted the monitorization work for the *in situ* instalation experiments of micropropagated plants.

All the studied *taxa* have testimony voucher specimens at the Herbarium of Coimbra, which support the research work in micropropagation and also the results obtained in the characterization and bioactivity of their essential oils (GONÇALVES *et al*., 2012, 2010b, 2010c, 2008a).

The obtained results are a contribute for the conservation and sustainable use of these target species, according with the following statement:

«Conservation of natural vegetation is compatible with human presence if some needed measures to the restoration of negative passed phenomena, the mitigation of present phenomena and the preservation of future phenomena were undertake» (TAULEIGNE-GOMES *et al*., 2004).

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ANNEXE I - COLLECTED MATERIAL (2005-2010)

1. ***Eryngium galioides*** Lam. - Fig 1.

Locations: Algarve, Loulé, Lagoa da Nave, Nave do Barão, 28.05.2008, *A. C. Tavares* 85 (COI).

2. ***Eryngium duriaei*** J. Gay ex Boiss. - Figs. 2 and 3.

Eryngium duriaei J. Gay ex Boiss. subsp. ***duriaei***

Locations: Beira Alta, Serra da Estrela, Cântaro Raso, 1700 m, 16.09.2008, *A. C. Tavares*, 112 (COI). Beira Alta, Serra da Estrela, Cântaro Raso, 1700 m, 11.07.2010.

Eryngium duriaei J. Gay ex Boiss. subsp. ***juresianum*** (M. Laínz) M. Laínz

Locations: Douro Litoral, Serra da Freita (Arouca), Frecha da Mizarela, 11.04.2005. Beira Litoral, Serra do Açor, between Colcurrinho and Senhora das Necessidades, 30.06.2005. *A. C. Tavares*, 8 (COI). Beira Litoral, Serra do Açor, between Colcurrinho and Senhora das Necessidades, 17.07.2006, *A. C. Tavares*, 54 (COI). Minho, Serra do Gerês, Mata da Albergaria, 26.07.2007, *A. C. Tavares*, 74 (COI). Beira Litoral, Serra do Açor, between Colcurrinho and Senhora das Necessidades, 20.09.2008, *A. C. Tavares*, 113 (COI). Beira Litoral, Serra do Açor, Colcurrinho, 19.06.2010, *A. C. Tavares*, 136 (COI); Beira Litoral, Serra do Açor, Colcurrinho, 21.09.2010. Minho, Serra do Gerês, Mata da Albergaria, edges of Homem river, 04.10.2010. Beira litoral, Arganil, Mata da Margaraça, 08.10.2010, *A. C. Tavares*, 143 (COI).

3. ***Daucus carota*** L.

Daucus carota L. subsp. ***carota***

Locations: Trás-os-Montes e Alto Douro, Serra da Nogueira, Rebordães, 13.07.2005, *A. C. Tavares*, s/n (COI). Beira Litoral, Serra do Açor, Piódão, 17.07.2006, *A. C. Tavares*, 53 (COI). Trás-os-Montes e Alto Douro, Serra da Nogueira, Rebordães, 25.07.2006, *A. C. Tavares*, 60 (COI). Beira Litoral, Cantanhede, Póvoa da Lomba, 13.07.2007, *A. C. Tavares*, 72 (COI). Beira Litoral, Cantanhede, Póvoa da Lomba, 29.07.2007, *A. C. Tavares*, 76 (COI). Beira Litoral, Cantanhede, Póvoa da Lomba, 22.06.2008, *A. C. Tavares*, 99 (COI). Beira Litoral, Coimbra, 16.10.2009, *A. C. Tavares*, 122 (COI); *A. C. Tavares*, 123 (COI). Cantanhede, Póvoa da Lomba, 30.05.2010. *A. C. Tavares*, 135 (COI). Beira

Litoral, Coimbra, Tentúgal, Meãs-do-Campo, 20.06.2010, *A. C. Tavares*, 137 (COI). Beira Litoral, Coimbra, Tentúgal, Meãs-do-Campo, 20.07.2010, *A. C. Tavares*, 139 (COI).

Daucus carota L. subsp. ***gummifer*** (Syme) Hook. fil. & G. Martens

Locations: Estremadura, Farol da Nazaré, 25.05.2005, *A. C. Tavares*, 2 (COI). Estremadura, Farol da Nazaré, 26.06.2005, *A. C. Tavares*, 6 (COI). Estremadura, Farol da Nazaré, 24.07.2005, *A. C. Tavares*, 12 (COI). Estremadura, Nazaré, Praia do Norte, 26.06.2005, *A. C. Tavares*, 5 (COI). Estremadura, Nazaré, Praia do Norte, 24.07.2005, *A. C. Tavares*, 13 (COI). Estremadura, Nazaré, Praia do Norte, 30.07.2005, *A. C. Tavares*, 15 (COI). Beira Litoral, Figueira da Foz, Cabo Mondego, 30.07.2005, *A. C. Tavares*, 14 (COI). Beira Litoral, Figueira da Foz, Vale das Pombas-Cabo Mondego, 10.08.2005, *A. C. Tavares*, 16 (COI). Estremadura, Farol da Nazaré, 21.05.2006, *A. C. Tavares*, 38 (COI). Estremadura, Farol da Nazaré, 25.06.2006, *A. C. Tavares*, 44 (COI). Estremadura, Farol da Nazaré, 22.07.2006, *A. C. Tavares*, 57 (COI). Estremadura, Nazaré, Praia do Norte, 25.06.2006, *A. C. Tavares*, 45 (COI). Estremadura, Nazaré, Praia do Norte, 22.07.2006, *A. C. Tavares*, 56 (COI). Estremadura, S. Pedro de Moel, 21.05.2006, *A. C. Tavares*, 39 (COI). Estremadura, S. Pedro de Moel, 25.06.20056, *A. C. Tavares*, 40 (COI). Estremadura, S. Pedro de Moel, 22.07.2006, *A. C. Tavares*, 55 (COI). Estremadura, Farol da Nazaré, 29.05.2010, *A. C. Tavares*, 132 (COI). Estremadura, Nazaré, Praia do Norte, 29.05.2010, *A. C. Tavares*, 133 (COI). Estremadura, S. Pedro de Moel, 29.05.2010, *A. C. Tavares*, 134 (COI). Beira Litoral, Figueira da Foz, Cabo Mondego, 25.07.2010, *A. C. Tavares*, 140 (COI).

Daucus carota subsp. ***halophilus*** (Brot.) A. Pujadas - Fig. 4.

Locations: Algarve, Cabo S. Vicente, 24.04.2005, *A. C. Tavares*, 1 (COI). Algarve, Cabo de S. Vicente, 30.12.2005, *A. C. Tavares*, 17 (COI). Algarve, Cabo S. Vicente, 24.04.2006, *A. C. Tavares*, 19 (COI). Algarve, Cabo S. Vicente, 18.06.2006, *A. C. Tavares*, 43 (COI). Algarve, Cabo S. Vicente, 01.07.2006, *A. C. Tavares*, 48 (COI). Algarve, Arrifana, 25.04.2006, *A. C. Tavares*, 20 (COI). Algarve, Arrifana, 17.06.2006, *A. C. Tavares*, 42 (COI). Baixo Alentejo, Zambujeira-do-Mar, 25.04.2006, *A. C. Tavares*, 21 (COI). Baixo Alentejo, Cabo Sardão, 27.04.2006, *A. C. Tavares*, 35 (COI). Baixo Alentejo, Cabo Sardão, 17.06.2006, *A. C. Tavares*, 41 (COI). Estremadura, Cabo Carvoeiro, 20.05.2006, *A. C. Tavares*, 36 (COI). Baixo Alentejo, Cabo Sardão, 07.06.2007, *A. C. Tavares*, 62 (COI). Algarve, Arrifana, 7.06.2007, *A. C. Tavares*, 63 (COI). Algarve, Cabo S. Vicente, 07.06.2007, *A. C. Tavares*, 64 (COI). Estremadura, Cabo Carvoeiro, 10.06.2007, *A. C. Tavares*, 65 (COI), Estremadura, Cabo Carvoeiro, 23.06.2007, *A. C. Tavares*, 67 (COI). Estremadura, Cabo da Roca, 07.06.2007, *A. C. Tavares*, 62 (COI). Estremadura, Cabo da Roca, 23.06.2007, *A. C. Tavares*, 68 (COI). Estremadura, Cabo Espichel, 23.06.2007, *A. C. Tavares*, 69 (COI). Baixo Alentejo, Cabo Sardão, 27.05.2008, *A. C. Tavares*, 80 (COI). Algarve, Arrifana, 27.05.2008, *A. C. Tavares*, 82 (COI). Estremadura, Cabo Carvoeiro, 01.06.2008, *A. C. Tavares*, 88 (COI). Algarve, Cabo de S. Vicente, 27.05.2008, *A. C. Tavares*, 83 (COI). Estremadura, Cabo Espichel, 10.06.2008, *A. C. Tavares*, 97 (COI). Estremadura, Cabo da

Roca, 10.06.2008, *A. C. Tavares*, 98 (COI). Algarve, Cabo S. Vicente, 14.05.2010, *A. C. Tavares*, 124 (COI). Algarve, Arrifana, 14.05.2010, *A. C. Tavares*, 125 (COI). Baixo Alentejo, Cabo Sardão, 14.05.2010, *A. C. Tavares*, 126 (COI). Estremadura, Cabo Espichel, 16.05.2010, *A. C. Tavares*, 129 (COI). Estremadura, Cabo da Roca, 16.05.2010, *A. C. Tavares*, 130 (COI). Estremadura, Cabo Carvoeiro, 16.05.2010. *A. C. Tavares*, 131 (COI). Algarve, Cabo S. Vicente, *in vitro* propagated plants, 09.06.2008, *A. C. Tavares*, 90 (COI); 09.6.2008, *A. C. Tavares*, 91 (COI); 10.6.2009, *A. C. Tavares*, 116 (COI); *A. C. Tavares*, 117 (COI).

Daucus carota L. subsp. ***maximus*** (Desf.) Ball

Locations: Alto Alentejo, Évora, S. Bento de Castris, Convento de Cartuxa, 14.07.2006, *A. C. Tavares*, 52 (COI). Alto Alentejo, between Évora and Arraiolos, 14.07.2007, *A. C. Tavares,* 73 (COI). Alto Alentejo, between Évora and Arraiolos, Cartuxa, 14.05.2010, *A. C. Tavares*, 127 (COI). Alto Alentejo, Montemo-o-Novo. 16.05.2010, *A. C. Tavares*, 128 (COI); 18.7.2010, *A. C. Tavares,* 138 (COI).

Daucus carota L. subsp. ***sativus*** (Hoffm.) Schübl. & G. Martens

Locations: Beira Litoral, Coimbra, Botanical Garden, nursery, 17.07.2008, *A. C. Tavares*, 102 (COI).

4. ***Bunium macuca*** Boiss. subsp. ***macuca*** - Fig. 5.

G. Mateo & S. López Udias (CASTROVIEJO, *Flora Ibérica* X: 66. 2003) point out this *taxon* to Alto Alentejo (AAl) province. The only specimen (COI; see Fig. 4) we have seen was collected near Setúbal, which is in Estremadura (E) and not in AAl. We did not find this *taxon* near Setúbal or in any other sites in Estremadura and Alto Alentejo yet.

5. ***Conopodium subcarneum*** (Boiss. & Reut.) Boiss. - Fig. 6.

Locations: Trás-os-Montes e Alto Douro, Tarouca, 01.07.2008, *A. C. Tavares*, 100 (COI). Beira Alta, S. Pedro do Sul, Serra da Arada, near Aldeia da Pena, 29.07.2008, *A. C. Tavares*, 103 (COI). Trás-os-Montes e Alto Douro, Serra da Nogueira, Bragança, Castelo, road to Rebordães, 09.09.2008, *A. C. Tavares*, 107 (COI).

6. ***Conopodium majus*** (Gouan) Loret subsp. ***marizianum*** (Samp.) López-Udias & Mateo - Fig. 7.

Locations: Beira Litoral, Serra de Montemuro, 27.06.2006, *A. C. Tavares*, 46 (COI). Beira litoral, Serra da Lousã, 27.06.2007, *A. C. Tavares*, 70 (COI). Beira Alta, Penedono, 03.07.2007, *A. C. Tavares*, 71 (COI). Trás-os-Montes e Alto Douro, Tabuaço, Serra de Chavães, 17.05.2009, *A. C. Tavares*, 114 (COI). Beira Litoral, Serra da Lousã, near Trevim, 18.05.2009, *A. C. Tavares*, 115 (COI).

7. ***Seseli montanum*** L. subsp. ***peixotoanum*** (Samp.) M. Laínz - Fig. 8.

Locations: Trás-os-Montes e Alto Douro, Bragança, Samil, Bragança, 17.06.2005, *A. C. Tavares* 4 (COI). Trás-os-Montes e Alto Douro, Bragança, between Carrazede

and Alimonde, 13.07.2005, *A. C. Tavares*, 10 (COI). Trás-os-Montes e Alto Douro, Bragança, Izeda, 13.07.2006, *A. C. Tavares*, 51 (COI). Trás-os-Montes e Alto Douro, Bragança, Samil, 25.07.2006, *A. C. Tavares*, 58 (COI). Trás-os-Montes e Alto Douro, Bragança, Alimonde, 25.7.2006, *A. C. Tavares*, 59 (COI). Trás-os-Montes e Alto Douro, Bragança, Samil, 22.06.2007, *A. C. Tavares*, 66 (COI). Trás-os-Montes e Alto Douro, Bragança, Alimonde, 11.09.2007, *A. C. Tavares*, 78 (COI). Trás-os-Montes e Alto Douro, Bragança, Alimonde, 09.09.2008, *A. C. Tavares*, 108 (COI). Trás-os-Montes e Alto Douro, Bragança, Samil, 09.09.2008, *A. C. Tavares*, 109 (COI). Trás-os-Montes e Alto Douro, Bragança, Alimonde, 10.09.2009. Bragança, Samil, 11.9.2008.

8. ***Angelica major*** Lag. - Fig. 9.

Locations: Beira Alta, Serra da Estrela, near Fonte de Jonjoba, 1100 m, 20.07.2005, *A. C. Tavares*, 11 (COI). Beira Alta, Serra da Estrela, between Fonte Paulo Martins and Covão da Vaca, 1700 m, 01.08.2006. Beira Alta, Serra da Estrela, near Senhora da Pedra tunnel, 16.09.2010; 01.8.2009, *A. C. Tavares*, 118 (COI). Beira Alta, Guarda, Porto da Carne, 28.07.2010.

9. ***Angelica pachycarpa*** Lange - Fig. 10.

Locations: Estremadura, Ilha Berlenga, 28.06.2005, *A. C. Tavares*, 7 (COI). Estremadura, Ilha Berlenga, 20.05.2006, *A. C. Tavares*, 37 (COI). Estremadura, Ilha Berlenga, 01.06.2008, *A. C. Tavares*, 87 (COI). Estremadura, Ilha Berlenga, 23.05.2008. Estremadura, Ilha Berlenga, 29.5.2008.

10. ***Ferula communis*** L. subsp. ***catalaunica*** (Pau ex Vicioso) Sánchez-Cuxart & Bernal - Fig. 11.

Locations: Beira Alta, Guarda, Porto da Carne, road to Guarda, 01.08.2006, *A. C. Tavares*, 61 (COI). Algarve, Espargal Loulé, Espargal, near Boliqueime, Alte, 28.05.2008, *A. C. Tavares*, 84 (COI). Estremadura, Óbidos, near the castle, 01.06.2008, *A. C. Tavares*, 89 (COI); 29.6.2008.

11. ***Ferulago capillaris*** (Link ex Spreng.) Cout. - Fig 12.

Locations: Beira Alta, Porto da Carne, Celorico da Beira, 13.07.2005, *A. C. Tavares*, 9 (COI). Beira alta, Celorico da Beira, 550 m, 01.08.2006. Minho, Serra do Gerês, Homem river, side by side with *Laserpitium* plants, 30.09.2007. Beira Alta, Guarda, Porto da Carne, road to Guarda, 16.09.2008, *A. C. Tavares*, 111 (COI). Beira Alta, Guarda, Porto da Carne, road to Guarda, 01.08.2008, *A. C. Tavares*, 119 (COI). Minho, Gerês, Mata da Albergaria, dry-bed of Homem river, 16.09.2009, *A. C. Tavares*, 121 (COI). Beira Alta, Porto da Carne, Guarda, 28.07.2010.

12. *Distichoselinum tenuifolium* (Lag.) García-Martín & Silvestre - Fig. 13

Locations: Algarve, Lagos, EN 125, between Bensafrim e Burgau, 01.7.2006, *A. C. Tavares*, 49 (COI). Algarve, Moncarapacho, Monte de S. Miguel, to Faro, km 2, 02.7.2006, *A. C. Tavares*, 50 (COI). Moncarapacho, Monte de S. Miguel, 11.8.2007. Moncarapacho, 29.5.2008, *A. C. Tavares*, 86 (COI); 09.6.2008, *A. C. Tavares*, 96 (COI). Lagos, Burgau, Alma Verde, EN 125, between Bensafrim and Burgau, 09.6.2008, *A. C. Tavares*, 94 (COI); 10.8.2008, *A. C. Tavares*, 106 (COI). Olhão-Faro, Moncarapacho, 09.8.2009. Olhão-Faro, Moncarapacho, 11.8.2010.

13. *Laserpitium eliasii* Sennen & Pau subsp. ***thalictrifolium*** (Samp.) P. Monts. - Fig. 14.

Locations: Minho, Serra do Gerês, between Ribeira de Monção and Portela do Homem, edges of the river, 720-740 m, 26.07.2007, *A. C. Tavares*, 75 (COI). Minho, Gerês, Mata da Albergaria, dry-bed of Homem river, 30.09.2007, *A. C. Tavares*, 79 (COI). Trás-os-Montes e Alto Douro, Bragança, Capela de S. Lourenço, 09.09.2008, *A. C. Tavares*, 110 (COI). Minho, Gerês, Mata da Albergaria, dry-bed of Homem river, 16.09.2009, *A. C. Tavares*, 120 (COI).

14. *Thapsia minor* Hoffmanns. & Link - Fig. 15

Locations: Beira Alta, Armamar, Vale de Tarouca, 825 m, 27.06.2006, *A. C. Tavares*, 47 (COI). Beira litoral, Piódão, 17.07.2006. Tarouca, Pena, São Macário, 01.07.2008, *A. C. Tavares*, 101 (COI). Beira Litoral, Tarouca, Queimada, Capela de S. Lourenço, 29.07.2008, *A. C. Tavares*, 104 (COI). Trás-os-Montes e Alto Douro, Armamar, capela de S. Lourenço, Queimadela, 01.07.2010, *A. C. Tavares*, 141 (COI). Beira Litoral, Vila Nova-de-Poiares, Mucelão, Carvalhal street, near S. Miguel de Poiares, 335 m, 01.07.2010, *A. C. Tavares*, 142 (COI).

