João Domingues de Almeida & Helena Freitas

Exotic flora of continental Portugal – a new assessment

Abstract

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We present a new assessment of the exotic flora of continental Portugal, six years after our last study. In 1999, we have assessed 500 exotic species of vascular plants (invasive or more or less naturalised). From 1999 to 2005, 64 new plant species records were added (12.8 % more), attaining a total of 564 taxa (including, as in precedent works, species, subspecies and some hybrids), belonging to 113 families (Almeida & Freitas 2006). At the present time, we have a list of 667 taxa (18.3 % more than at our previous work, and more than 17.9 % of the total number of taxa of the Portuguese flora), included in 124 different families.

Introduction

Six years after completing a first study of the exotic subspontaneous flora of continental Portugal (Almeida 1999; Almeida & Freitas 2001), we presented a revision in Almeida & Freitas, 2006. Here we present a new assessment, with much more valuable data of this most dynamic exotic flora.

As we have written before (Almeida & Freitas 2001), the expansion of subspontaneous or exotic invasive plants is threatening the Portuguese native flora, representing a severe environmental problem.

Some very rich surveys on the introduced plant species in Spain were recently published (e.g. Del Monte & Aguado 2003; Sanz-Elorza & al. 2004; Romero Buján 2007).

Relevant papers, theses, books, blogs and posters on this subject, related to Portugal, were published in the past, some very recently and some still being published (Colmeiro 1891; Coutinho 1920; Pinto da Silva 1942; Fernandes 1955; Pinto da Silva 1963, 1971, 1975; Almeida & Freitas 2000, 2002; Araújo & al. 2004–; Marchante & Marchante 2007; Marchante & al. 2009; Aguiar & al. 2009–; Forte & al. 2011).

Material and methods

In this work we have used the bibliography published mainly in the last six years (2005–2011) and also field observations. The most relevant bibliographic sources of new records of exotic species were: a) a new volume of Med-Checklist (Greuter & von

Raab-Straube 2008); b) six new volumes of *Flora iberica* (Castroviejo & al. 2005, 2007a, 2007b, 2008, 2010a, 2010b); c) a book about trees and shrubs of Portugal (Bingre & al. 2007); d) a book about invasive species in continental Portugal (Marchante & al. 2009); e) three PhD theses (Ribeiro 2006; Almeida 2009; Pereira 2009); e) some published notes (Almeida & Matos 2007; Verloove & Sánchez Gullón 2008); f) some accounts of genera for *Flora iberica* published in the Internet (Aedo 2008; Muñoz Garmendia & Navarro 2009; Navarro & Muñoz Garmendia 2008; Sánchez Pedraja 2008; Sobrino Vesperinas & Sanz-Elorza 2008; Valdés 2008); g) some poster presentations at botanical meetings (Forte & al. 2011); and h) other information available in the Internet (Beja & al. 2008; Aguiar & al. 2009–; Araújo & al. 2004–; Garcia 2009).

The taxonomy of *Asteraceae* (*Compositae*) was carefully revised according to Greuter & von Raab-Straube (2008).

We have used the classification of synanthropic plant species of Kornas (1990).

In this work we don't include the apophyta or autochtonous synanthropic species (e.g. *Pinus pinaster* Aiton, which is native in Portugal). We only consider the Anthropophyta, or alochtonous, exotic or non-native synanthropic species.

Results

We have to agree with Chodat (1913): «C'est une des caractéristiques du Portugal que la grande abondance de mauvaises herbes d'origine étrangère» and with Pinto da Silva & al. (1958): «Shall we add that for nearly a century now the introduced *Eucalypti* and *Acaciae* have also contributed to the spoiling of the landscape?». Recently, another eminent botanist confirmed this opinion: «Portugal has the reputation of being particularly "rich" in aggressive alien plants and that reputation is fully confirmed (...). From *Eucalyptus* to *Carpobrotus*, many naturalised exotics work together in putting the country's rich native flora at risk» (Greuter 2002).

From 564 taxa of vascular exotic more or less naturalised species (including species, subspecies and also some hybrids) in 2005, or about 17 % of the total flora (ca. 3320 species and subspecies), we now reach the very impressive figure of 667 taxa (a higher proportion: 17.9 % of the total Portuguese flora – about 3725 taxa, according to our most recent estimation), belonging to 124 families. In the period 2005-2011 we found 103 new taxa records (about 18.3 % of the previous total number).

The main results of our work are summarised in table I, including all newly found exotic more or less naturalised 103 taxa (species, subspecies and hybrids) that we know from continental Portugal (present and past).

Table 1. Exotic vascular plant species recently found (invasive, potentially invasive or more or less naturalised) in continental Portugal.

Taxon name	Family	Origin	Phyto type	Year of 1st report	Xeno type
Abutilon grandifolium (Willd.) Sweet	*Malvaceae*	S America	Ph	2010	Epoe
Abutilon megapotamicum (Spreng.) St. Hil. & Naud.	*Malvaceae*	S America	Th	2006	Dia
Abutilon pictum (Hooker & Arnott) Walpers	*Malvaceae*	S America	Th	2006	Dia
Agave attenuata Salm-Dyck	*Agavaceae*	N America	H	2007	Dia
Agave ferox K. Koch	*Agavaceae*	N America	H	2007	Dia
Allium cepa L.	*Alliaceae*	Eurasia	Cr	2006	Dia
Allium narcissiflorum Vill.	*Alliaceae*	Eurasia	Cr	1885	Dia
Allium sativum L.	*Alliaceae*	Eurasia	Cr	2001	Dia
Amorpha fruticosa L.	*Fabaceae*	N America	Ph	2008	Epoe
Antirrhinum majus L.	*Asteraceae*	Hybrid	Ch	1984	Dia
Arum ×nigropunctatum Lázaro Ibiza	*Araceae*	Hybrid	Cr	1913	Dia
Asparagus officinalis L. subsp. *officinalis*	*Asparagaceae*	Medit. Region	Cr	1804	Dia
Asparagus setaceus (Kunth) Jessop	*Asparagaceae*	Africa	Cr	2000	Dia
Atriplex sagittata Borkh.	*Chenopodiaceae*	Eurasia	Th	1990	Dia
Bauhinia variegata L.	*Fabaceae*	Eurasia	Ph	2011	Epoe
Berberis julianae C.K. Schneid.	*Berberidaceae*	Eurasia	Ph	2011	Epoe
Berberis vulgaris L.	*Berberidaceae*	Eurasia	Ph	1804	Epoe
Brassica rapa L. subsp. *rapa*	*Brassicaceae*	Eurasia	Th	2002	Dia
Callirhoe involucrata (Torr. & Gray) Gray	*Malvaceae*	N America	H	2011	Dia
Camelina alyssum (Mill.) Thell.	*Brassicaceae*	Eurasia	Th	1944	Dia
Campsis radicans (L.) Bureau	*Bignoniaceae*	N America	Ph	2010	Dia
Cardiospermum halicacabum L.	*Sapindaceae*	Trop. Regions	H	2009	Dia
Castanea crenata Siebold & Zucc.	*Fagaceae*	Eurasia	Ph	1990	Agr
Casuarina equisetifolia L.	*Casuarinaceae*	Australia	Ph	2004	Dia
Chamaesyce canescens subsp. *massiliensis* (DC.) Soják	*Euphorbiaceae*	Medit. Region	Th	1998	Agr
Cicer arietinum L.	*Fabaceae*	Eurasia	Th	2005	Dia
Cichorium calvum Asch.	*Asteraceae*	Eurasia	Th	1989	Dia
Commelina communis L.	*Commelinaceae*	Eurasia	Th	2011	Agr
Cordyline australis (G. Forst.) Endl.	*Dracaenaceae*	New Zealand	Ph	2006	Dia
Coriaria nepalensis Wall.	*Coriariaceae*	Eurasia	Ph	2007	Epoe
Cosmos bipinnatus Cav.	*Poaceae*	N America	Th	1993	Dia
Crassula campestris (Eckl. & Zeyh.) Walp.	*Crassulaceae*	S Africa	Th	2007	Epoe
Cymbalaria aequitriloba (Viv.) A. Cheval.	*Scrophulariaceae*	Medit. Region	Ch	1990	Dia
Cytisus ×praecox Bean	*Fabaceae*	Hybrid	Ph	2002	Dia
Echium arenarium Guss.	*Boraginaceae*	Medit. Region	H	1846	Agr
Echium parviflorum Moench	*Boraginaceae*	Medit. Region	Th	1846	Agr
Eleocharis bonariensis Nees	*Cyperaceae*	S America	H	2008	Agr
Epilobium brachycarpum C. Presl	*Onagraceae*	N America	Th	2007	Epoe
Erigeron bilbaoanus (E.J. Remy) Cabrera	*Asteraceae*	S America	Th	2005	Epoe
Gaillardia aristata Pursh	*Asteraceae*	N America	H	2008	Dia
Gastridium phleoides (Nees & Meyen) C.E. Hubbard	*Poaceae*	Medit. Region	Th	1971	Dia
Gnaphalium simplicicaule Willd. ex Spreng.	*Asteraceae*	S America	H	2011	Epoe
Gnidia carinata Thunb.	*Thymelaeaceae*	S Africa	Ph	1880	Dia
Hippophae rhamnoides L.	*Elaeagnaceae*	Eurasia	Ph	2011	Epoe
Hordeum distichon L.	*Poaceae*	Eurasia	Th	1998	Dia
Hordeum vulgare L.	*Poaceae*	Eurasia	Th	1998	Dia
Iberis amara L. subsp. *amara*	*Brassicaceae*	Eurasia	Th	1804	Dia
Ipomoea purpurea (L.) Roth	*Convolvulaceae*	America	Ph	2007	Epoe
Kerria japonica (L.) DC.	*Rosaceae*	Eurasia	Ph	2006	Dia
Lactuca sativa L.	*Asteraceae*	Eurasia	Th	2005	Dia
Leucaena leucocephala (Lam.) De Wit	*Fabaceae*	N America	Ph	2011	Epoe
Ligustrum sinense Lour.	*Oleaceae*	Eurasia	Ph	1996	Epoe
Limoniastrum monopetalum (L.) Boiss.	*Plumbaginaceae*	Medit. Region	Ph	1689	Agr
Luzula elegans Lowe	*Juncaceae*	Macaronesia	Th	1847	Agr
Malus domestica (Borkh.) Borkh.	*Rosaceae*	Eurasia	Ph	2002	Dia
Melia azedarach L.	*Meliaceae*	Eurasia	Ph	2008	Dia
Micromeria juliana (L.) Benth.	*Lamiaceae*	Medit. Region	Ch	1661	Agr
Morus nigra L.	*Moraceae*	Eurasia	Ph	1913	Dia
Nemophila maculata Benth. ex Lindl.	*Hydrophyllaceae*	N America	Th	2011	Dia
Nephrolepis cordifolia (L.) C. Presl	*Nephrolepidaceae*	Trop. Regions	Cr	2000	Epoe
Oenothera biennis L.	*Onagraceae*	N America	H	1890	Epoe

Opuntia elata Link & Otto ex Salm-Dyck	*Cactaceae*	S America	Ph	1910	Epoe
Oxalis corniculata L.	*Oxalidaceae*	Eurasia	Ch	1500	Arch
Oxalis vallicola (Rose) R. Knuth	*Oxalidaceae*	America	Cr	2008	Epoe
Pavonia hastata Cav.	*Malvaceae*	S America	Ph	1997	Dia
Pavonia sepium A. St.-Hil.	*Malvaceae*	S America	Ph	2011	Dia
Pelargonium ×hortorum L.H. Bailey	*Geraniaceae*	S Africa	Ch	1971	Dia
Pelargonium peltatum (L.) L'Hér.	*Geraniaceae*	S Africa	Ch	1971	Dia
Pelargonium ranunculophyllum (Eckl. & Zeyh.) Baker	*Geraniaceae*	S Africa	Ch	2011	Dia
Phormium tenax J.R. Forst. & G. Forst.	*Agavaceae*	New Zealand	Ph	2006	Dia
Phyllostachys aurea (Carrière) A.C. Rivière & C. Rivière	*Poaceae*	Eurasia	Ph	2006	Epoe
Phyllostachys nigra (Lindl.) Munro	*Poaceae*	Eurasia	Ph	2006	Epoe
Pisum sativum L. subsp. *sativum* var. *arvense* (L.) Poir.	*Fabaceae*	Unknown	Th	1968	Epoe
Polystichum falcatum (L. f.) Diels	*Dryopteridaceae*	Trop. Regions	Ch	2010	Epoe
Pterocarya fraxinifolia (Poir.) Spach	*Juglandaceae*	Eurasia	Ph	2011	Epoe
Pyracantha rogersiana (A.B. Jackson) Bean	*Rosaceae*	Eurasia	Ph	2011	Dia
Quercus imbricaria Michaux	*Fagaceae*	N America	Ph	2000	Epoe
Rosa pimpinellifolia L.	*Rosaceae*	Eurasia	Ph	2009	Agr
Rubus laciniatus Willd.	*Rosaceae*	Unknown	Ph	2010	Agr
Salvinia molesta D.S. Mitchell	*Salviniaceae*	S America	Cr	2008	Agr
Satureja montana L. subsp. *montana*	*Lamiaceae*	Medit. Region	Ch	2007	Agr
Saxifraga stolonifera Meerb.	*Saxifragaceae*	Eurasia	Ch	2005	Dia
Securigera varia (L.) Lassen	*Fabaceae*	Eurasia	H	2009	Dia
Sedum dendroideum Mociño & Sessé	*Crassulaceae*	N America	Ch	1999	Dia
Solanum laciniatum Aiton	*Solanaceae*	Australia	Ph	2008	Dia
Solanum rostratum Dunal	*Solanaceae*	America	Th	2003	Epoe
Solanum wendlandii Hook. f.	*Solanaceae*	America	Ph	2011	Epoe
Sorghum bicolor (L.) Moench	*Poaceae*	Africa	Th	1998	Dia
Spartina patens (Aiton) Muhl.	*Poaceae*	N America	Cr	1900	Agr
Symphytum officinale L.	*Boraginaceae*	Eurasia	Ch	1788	Dia
Tetragonolobus conjugatus subsp. *requienii* (Sanguin.) E. Domínguez & Galiano	*Fabaceae*	Medit. Region	Th	2000	Dia
Tetragonolobus purpureus Moench	*Fabaceae*	Medit. Region	Th	2000	Dia
Teucrium dunense Sennen	*Lamiaceae*	Medit. Region	Ch	2001	Agr
Tilia tomentosa Moench	*Tiliaceae*	Medit. Region	Ph	2006	Dia
Triticum durum Desf.	*Poaceae*	Unknown	Th	1998	Dia
Verbena rigida Spreng.	*Verbenaceae*	S America	Ch	2000	Epoe
Viola odorata L.	*Violaceae*	Medit. Region	H	b. 1500	Arch
Viola × wittrockiana Gams	*Violaceae*	Hybrid	Th	2001	Dia
Vitis labrusca L.	*Vitaceae*	N America	Ph	1879	Epoe
Wisteria sinensis (Sims) Sweet	*Fabaceae*	Eurasia	Ph	2006	Dia
Xeranthemum annuum L.	*Asteraceae*	Eurasia	Th	1804	Dia
Zea mays L.	*Poaceae*	N America	Th	2006	Dia
Zinnia elegans Jacq.	*Asteraceae*	N America	Th	2007	Dia

Phytotype according to Raunkiaer classification (1934): Ch = Chamephyte, Cr = Criptophyte, H = Hemicriptophyte, Ph = Phanerophyte, Th = Therophyte. Xenotype or type of exotic species according to Kornas classification (1990), simplified: Agr = Agriophyte, Arch = Archeophyte, Dia = Diaphyte, Epoe = Epoecophyte. Original region of the taxa: Medit. Region = Mediterranean Region, NZ = New Zealand, Trop. Regions = Tropical Regions, N = North, S = South. The year of first reported naturalization of exotic species may be: a) the year of collection of the first herbarium specimen; b) the year of the first observation of the referred taxon; c) the year of publication of the first bibliographic reference. For the archeophytes (Arch) we indicate the year of introduction as b. 1500 (before the year 1500 A.D. approximately corresponding with the discovery of America).

Conclusions

We recognise now a total number of 667 taxa of vascular exotic more or less naturalised species (including species, subspecies and also some hybrids), corresponding to precisely 17.9 % of the total flora of continental Portugal (ca. 3725 species, subspecies, hybrids and other taxa).

In the period 2005-2011 we found 103 new plant species records (about 18.3 % more than the previous total number).

These 667 taxa are included in 124 families. Pteridophyta, with 11 species (1.6 %) belonging to 9 families, are a small group. The same is true for Gymnospermae, with 14 species (2.1 %), belonging to 2 families. Angiospermae are the great majority of our exotic flora, with 642 taxa (96.3 % of the total number), belonging to 113 families. Dicotyledones are the largest group, with 521 taxa (78.1 %), included in 91 families. Monocotyledones are other major group, with 121 taxa (18.1 %), belonging to 22 families. The previous proportions between these large groups (Almeida 1999; Almeida & Freitas 2001; 2006) remain more or less constant.

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Address of the authors:
João Domingues de Almeida & Helena Freitas,
Department of Life Sciences, Faculty of Sciences and Technology. University of Coimbra. 3000 Coimbra. Portugal. E-mail: jddalmeida@hotmail.com; hfreitas@ci.uc.pt