

A checklist of the exclusive vascular flora of Sardinia with priority rankings for conservation

Gianluigi Bacchetta*, Giuseppe Fenu & Efisio Mattana

Centro Conservazione Biodiversità (CCB), Dipartimento di Scienze della Vita e dell'Ambiente,
Università degli Studi di Cagliari, v.le Sant'Ignazio da Laconi, 13, 09123 Cagliari, Italy. bacchet@unica.it

Abstract

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Sardinia is the second-largest island in the Mediterranean Sea and its isolation and high geological diversity have created a wide range of habitats with high levels of endemism, especially on its mountain massifs, where there are conditions of ecological insularity. In this study the exclusive endemic flora of Sardinia has been updated to 168 taxa, 139 of which are species, 23 subspecies, 4 varieties and 2 hybrids, belonging to 37 families and 72 genera. Despite this rich biodiversity and the threats to these species, few biological conservation studies have been carried out up to now. A conservation project for the most threatened exclusive endemic species of Sardinia was therefore funded in 2007 by the "Regione Autonoma della Sardegna". To categorize these species of conservation interest, a priority list was created by applying 11 parameters based on rarity, threats and protection status. This work allowed the identification of the most threatened species of the Sardinian endemic flora.

Key words: endemics, IUCN, Mediterranean islands, threatened plants.

INTRODUCTION

The Mediterranean basin, with 11.8 endemic plants per 100 km², has been recognized as one of the priority regions for conservation in Europe and identified as one of the 34 most important "biodiversity hotspots" of the planet (Mittermeier & al., 2004). It contains 10 areas characterized by high species richness; among these, the Tyrrhenian Islands are characterized by the presence of approximately 6,000 plant species (Médail & Quézel, 1997), of which 10-12% are endemic (Contandriopoulos, 1990; Mariotti, 1990; Gamisans & Jeanmonod, 1995; Médail & Quézel, 1997; Bacchetta & Pontecorvo, 2005).

Sardinia, situated in the Western Mediterranean basin, is the second largest island in the Mediterranean Sea (after Sicily). Its isolation and high geological diversity have created a wide range of habitats, with high levels of endemism, especially on its mountain massifs, where there are conditions of ecological insularity (Médail & Quézel, 1997). The Sardinian flora consists of 2,408 taxa, including 2,295 species (Conti & al., 2005), of which 347 are endemics (e.g. narrow

Resumen

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Cerdeña es la segunda isla más grande del Mediterráneo y su aislamiento y la gran diversidad geológica han originado una amplia gama de hábitats que albergan un elevado número de endemismos, especialmente en los macizos, donde se dan condiciones de insularidad ecológica. En este estudio se ha actualizado el catálogo de la flora endémica exclusiva de Cerdeña, que está integrada por 168 táxones, de los cuales 139 son especies, 23 subespecies, 4 variedades y 2 híbridos, pertenecientes a 37 familias y 72 géneros. A pesar de esta rica biodiversidad y de las amenazas para estas especies, son pocos los estudios de biología de la conservación que se han llevado a cabo hasta ahora. Por lo tanto, la "Regione Autonoma della Sardegna" financió en 2007 un proyecto de conservación de las especies endémicas exclusivas de Cerdeña más amenazadas. Para clasificar el estado de conservación de estas especies, se ha creado una lista de prioridades mediante la aplicación de 11 parámetros basados en los criterios de rareza, amenaza y estado de protección. Este trabajo ha permitido identificar la mayoría de las especies amenazadas de la flora endémica de Cerdeña.

Palabras clave: endémicas, IUCN, islas mediterráneas, plantas amenazadas.

endemics, Sardinian endemics, Corso-Sardinian endemics, Corso-Sardinian-Balearic endemics), with 45.8% being exclusive Sardinian endemics (Bacchetta & al., 2005).

About a hundred species endemic to Sardinia (Conti & al., 1992, 1997; Scoppola & Spampinato, 2005) have been recognized as threatened; furthermore, five exclusive endemics [i.e. *Aquilegia barbaricina* Arrigoni & E. Nardi, *A. nuragica* Arrigoni & E. Nardi, *Lamyropsis microcephala* (Moris) Dittrich & Greuter, *Polygala sinisica* Arrigoni and *Ribes sardoum* Martelli] have been included by the IUCN/SSC - Mediterranean Island Plant Specialist Group in the "Top 50 Mediterranean Island Plants" to be urgently conserved (Montmollin de & Strahm, 2005). Despite this rich biodiversity and the threats to these species, few biological conservation studies have been carried out in Sardinia (Fenu & Mattana, 2011). The level of threat to a species represents one of the most important parameters for the creation of target plant lists. The criteria established by the International Union for the Conservation of the Nature (IUCN, 2001) are widely employed as the gold standard for

* Corresponding author.

information on the conservation status of species (e.g. Grammont de & Cuarón, 2006; Rodrigues & al., 2006; Hoffman & al., 2008). During the last decade, nature conservation in Europe has been focused on the implementation of the Habitat Directive (DIR. 92/43/EEC) and the Natura 2000 network. Natura 2000 is by far the most important conservation effort implemented in Europe (Maiorano & al., 2007) and it was proposed as the main strategy to meet the target of halting (or at least significantly reducing) biodiversity loss by 2010 (Balmford & al., 2005). Its main goal is either to maintain or restore a 'favorable' conservation status for species and habitat types of special importance.

In the Mediterranean area, plant conservation priority-settings at finer-scales (i.e. biogeographical province, see Bacchetta & al., 2011b) should be preferred due to biogeographic and cultural diversity and regional threats (Médail & Quezel, 1999). Moreover, when working in such species-rich areas, "priority lists" should be created in order to identify the target species for conservation measures, since biodiversity conservation policies have to operate with only limited resources (Balmford & al., 2005).

Some attempts to set conservation priorities have been made at a regional level. In particular, Domínguez Lozano & al. (2003) found that an overall pattern in conservation practice of threatened Iberian plants (including the Balearic

Islands) seems to be defined by their ecological specificity, geographical rarity and rate of threat. Jiménez-Alfaro & al. (2010), based on the results achieved in a study focused on the Cantabrian Range (Spain), suggested that different point-scoring procedures might have a high impact on the application of priority lists for selecting conservation targets. Gauthier & al. (2010), compared three criteria associated with rarity in the Languedoc-Roussillon region (France) with the aim of establishing regional-level priorities; they identified the "regional responsibility" (i.e. highest scores given to species whose distribution is endemic to the study area) as the first order of priority at local level.

In this context, a project, funded in 2007 by the "Regione Autonoma della Sardegna", was awarded to the University of Cagliari for the conservation of the most threatened endemic species of the Island. The exclusive endemic vascular flora of Sardinia and the priority list that were elaborated within the framework of this project are presented here.

MATERIAL AND METHODS

Floristic researches were undertaken throughout the Island between 2004 and 2010. During this period a number of excursions were made to study the different seasonal aspects. Specimens and seeds collected in the field were stored in the Herbarium CAG and in the Sardinian Germplasm Bank

Table 1. Parameters used to calculate the Priority list.

Parameter	Description	Values
Endemicity	Based on biogeographic patterns	1: endemic taxa spread throughout the Island (Sardinian sub-province); 2: endemic taxa limited to a biogeographic sector or subsector; 3: narrow endemics
Rarity	Nº of populations	1: $n > 20$; 2: $11 < n < 20$; 3: $6 < n < 10$; 4: $2 < n < 5$; 5: $n = 1$
	Area of occupancy (AOO)	1: $AOO > 100 \text{ km}^2$; 2: $10 < AOO < 100 \text{ km}^2$; 3: $1 < AOO < 10 \text{ km}^2$; 4: $0.1 < AOO < 1 \text{ km}^2$; 5: $0.0 < AOO < 0.1 \text{ km}^2$
	Population dimensions	1: $n > 50.000$; 2: $5001 < n < 50.000$; 3: $501 < n < 5000$; 4: $51 < n < 500$; 5: $n < 51$
	Ecological range	1: $n > 4$; 2: $n = 4$; 3: $n = 3$; 4: $n = 2$; 5: $n = 1$
Threats level	Natural threats	1: very low (no quantifiable disturbances); 2: low (no habitat alterations, significant reproductive individuals number decrease and population area size reduction); 3: moderate (VU E); 4: high (EN E); 5: extreme (CR E)
	Anthropic threats	1: very low (no quantifiable disturbances); 2: low (no habitat alterations, significant reproductive individuals number decrease and population area size reduction); 3: moderate (VU E); 4: high (EN E); 5: extreme (CR E)
	Decline	1: $x < 10\%$; 2: $10 < x < 30\%$; 3: $30 < x < 50\%$ (VU A2); 4: $50 < x < 80\%$ (EN A1+2); $x \bullet 80\%$ (CR A2)
Protection status	Dir. 92/43/EEC	1: NP (non priority); 2: P (priority)
	IUCN Red list	0: NE; 1: DD; 2: LC; 2.5: LR (IUCN, 1994); 3: NT; 4: VU; 5: EN; 6: CR; 7: EW; 8: EX
	Mediterranean Top50 IUCN	0: taxa not inserted; 1: taxa inserted

(BG-SAR), respectively. Bibliographic and herbarium researches were made at CAG, CAT, FI, NAP, PAL, SASSA, SS, TO, Wand Z. Collected specimens were identified with "Flora d'Italia" (Pignatti, 1982), "Flora Europaea" (Tutin & al., 1964-80; 1993), "Le piante endemiche della Sardegna" (Arrigoni & al., 1977-1991), "Flora Corsica" (Jeanmonod & Gamisans, 2007), "Flora dels Països Catalans" (Bolòs & Vigo, 1984-2001) and "Flora Iberica" (Castroviejo, 1986-2011). Growth and life forms were determined in the field following the Raunkiaer classification (1934) and using the abbreviations proposed by Pignatti (1982).

A priority list was created by integrating the three kinds of lists reported in Grammont de & Cuarón (2006): (1) lists based on the degree of biological threat, (2) conservation lists and (3) international and national protection catalogues. The establishment of the criteria for conservation priorities, and the evaluation and selection of the target *taxa* were based on the analysis of 11 parameters (Table 1), and the final score was determined by summing the values calculated for each parameter; data were obtained from the literature, from herbarium specimens and field surveys. To determine the protection status, extra values were attributed to those *taxa* inserted in international and national protection catalogues. In particular, the Annexe II of the European Directive "Habitat", the Italian national (Conti & al., 1992) and regional (Conti & al., 1997) Red Lists, as updated by Pignatti & al. (2001) and Scoppola & Spampinato (2005), the IUCN Red list (IUCN, 2010) and the IUCN Top50 species of the Mediterranean islands (Montmollin de & Strahm, 2005) were consulted (Table 1). The adopted taxonomic nomenclature followed the Annotated Checklist of the Italian Vascular Flora (Conti & al., 2005).

RESULTS

The exclusive vascular flora of Sardinia consists of 168 *taxa*, 139 of which are species, 23 subspecies, 4 varieties and 2 hybrids, belonging to 37 families and 72 genera (Appendix 1). Among the Angiosperms, dicots prevail with 151 *taxa* (89.88% of the whole exclusive endemic flora), while monocots comprise 17 *taxa* (10.12%). Pteridophyte and Gymnosperm *taxa* are not present among the exclusive Sardinian endemics. The most represented families (Fig. 1) are Plumbaginaceae (37 *taxa*, 22.0%), followed by Asteraceae (21, 12.5%) and Fabaceae (19, 11.3%); the Caryophyllaceae (16, 9.5%), Boraginaceae (8, 4.8%) and Orchidaceae (6, 3.6%) are also significant.

In Fig. 2, the most abundant genera are indicated; the most represented are *Limonium* (33 *taxa*, 19.6%), *Genista* (12, 7.1%), *Dianthus* (8, 4.8%), *Anchusa*, *Astragalus*, *Centaurea*, *Ophrys* and *Silene* (6, 3.6%).

The life form analysis (Fig. 3) highlighted a clear predominance of chamaephytes (77 *taxa*, 45.8%) and hemicryptophytes (37, 22.0%), followed by phanerophytes (13.1%; 10.7% nano-phanerophytes + 2.4% macro-phanerophytes), geophytes (21, 12.5%) and therophytes (11, 6.5%).

Nine exclusive endemics are included in the Annexe II of the Habitat Directive and 8 of these are considered as priority species (*Astragalus maritimus* and *A. verrucosus*, *Centaurea*

horrida, *Lamyropsis microcephala*, *Limonium insulare* and *L. pseudolaetum*, *Linum muelleri* and *Ribes sardoum*). Some 33 *taxa* are listed in the Italian national (Conti & al., 1992) and 60 in the regional (Conti & al., 1997) red lists, with 9 of them being considered critically endangered (CR), 10 endangered (EN), 13 vulnerable (VU) and 28 at low risk (LR).

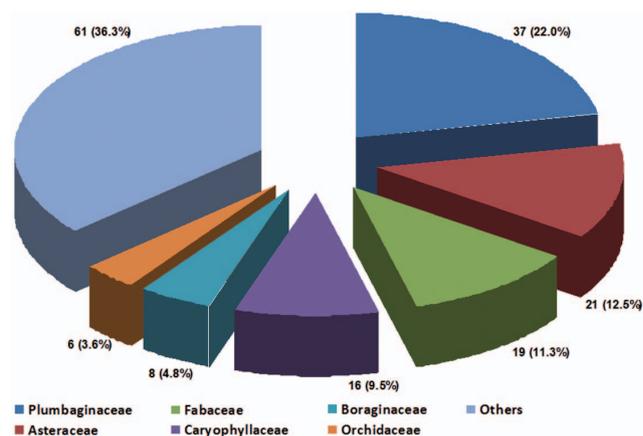


Fig. 1. The most represented families of the exclusive vascular flora of Sardinia.

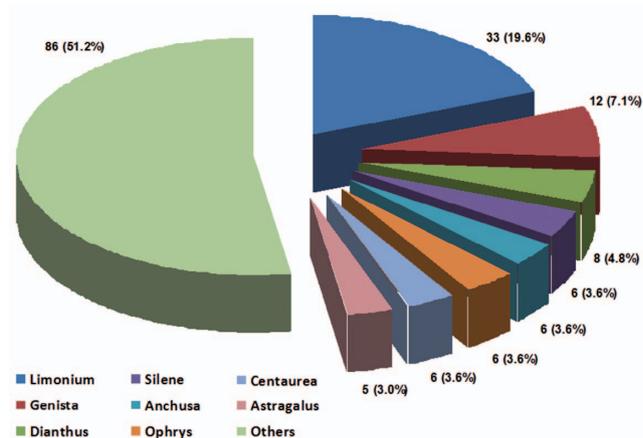


Fig. 2. The most represented genera of the exclusive vascular flora of Sardinia.

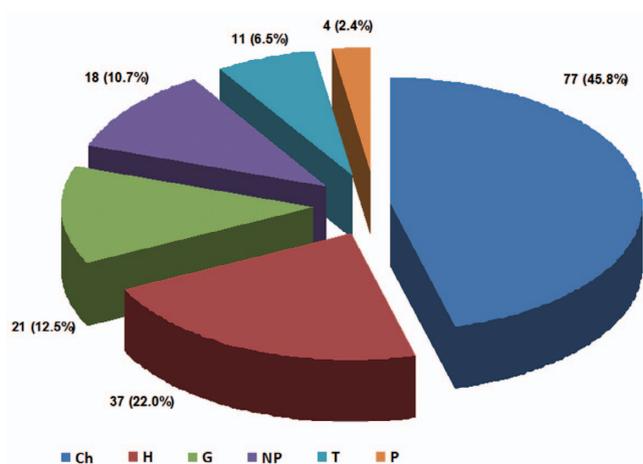


Fig. 3. Biological spectrum of the exclusive vascular flora of Sardinia.

Table 2. The ten most threatened exclusive endemic species of Sardinia.

Nº	Taxon	Family	IUCN Category	Dir 92/43/CEE	Score
1	<i>Ribes sardoum</i> Martelli	Grossulariaceae	CR B1ab(v)+2ab(v) (IUCN, 2010)	P	41
2	<i>Polygala sinisica</i> Arrigoni	Polygalaceae	CR B1ab(ii)+2ab(ii) (IUCN, 2010)		40
3	<i>Lamyropsis microcephala</i> (Moris) Dittrich & Greuter	Asteraceae	CR B1ab(iii)+2ab(iii) (IUCN, 2010; Fenu & al., 2011)	P	38
4	<i>Anchusa littorea</i> Moris	Boraginaceae	CR B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v) (Fenu & Bacchetta, 2008)		37
5	<i>Centranthus amazonum</i> Fridl. & A. Raynal	Valerianaceae	CR B1ab(iii,iv)+2ab(iii,iv); D (IUCN, 2010)	NP	34
6	<i>Aquilegia nuragica</i> Arrigoni & E. Nardi	Ranunculaceae	CR B1ab(v)+2ab(v); D (IUCN, 2010)		34
7	<i>Dianthus morisianus</i> Vals.	Caryophyllaceae	CR B1ab(i,ii,iii) + 2b(i,ii,iii) (Fenu & al., 2010)		34
8	<i>Aquilegia barbaricina</i> Arrigoni & E. Nardi	Ranunculaceae	CR B1ab(ii,iv)+2ab(ii,iv); D (IUCN, 2010)		34
9	<i>Astragalus maritimus</i> Moris	Fabaceae	CR (Bacchetta & al., 2011c)	P	33
10	<i>Astragalus verrucosus</i> Moris	Fabaceae	CR B1ab(i,ii,iii) (Bacchetta & al., 2011c)	P	33

Regarding the conservation priorities, it was possible to assign a score on the basis of the considered parameters for all the species, with the exception of *Centaurea forsythiana*, *Limonium multifurcatum*, *Medicago intertexta* var. *tuberculata*, *Ophrys scolopax* subsp. *sardoa*, *Senecio siculus* var. *nemoralis* and *Senecio vulgaris* var. *tyrrhenus*, for which data were deficient (see Appendix). The ten most threatened species are reported in Table 2, with scores ranging from 33 for *Astragalus maritimus* and *A. verrucosus* to a maximum of 41 for *Ribes sardoum*, which is therefore the most threatened Sardinian endemic according to our results. All these species are catalogued in the official IUCN Red List (IUCN, 2010) with the exception of *Anchusa littorea*, *Dianthus morisianus*, *Astragalus maritimus* and *A. verrucosus*, for which IUCN categories have been proposed by different authors (see Fenu & Bacchetta, 2008; Fenu & al., 2010; Bacchetta & al., 2011c). All these species are considered, or have been proposed for consideration, under the Critically Endangered (CR) category.

DISCUSSION

This work allowed the production of an exhaustive checklist of the exclusive endemic vascular flora of Sardinia, thus updating the previous works in which the endemic component of the Island was analyzed (Bacchetta & al., 2005; Conti & al., 2005).

The percentage of exclusive *taxa* of Sardinia (6.9%) is similar to that of Corsica (6.3%), thus providing further evidence for the floristic autonomy of the Corso-Sardinian flora, due to their geographical and ecological isolation (Médail & Quézel, 1997; Mansion & al., 2008). The preponderance of species belonging to the family Plumbaginaceae was mainly due to the high number of *Limonium* species endemic to the Island. *Limonium* is a taxonomically complex group, mainly comprising sexual and apomictic perennial herbs and sub-shrubs that are distributed worldwide but

with a centre of diversification in the Mediterranean basin, where several hundred endemic species occur (Rosselló & Castro, 2008). In Sardinia 38 species have been recognized (Arrigoni & Diana, 1999). The Tyrrhenian area also represents a speciation centre for many plant groups associated with Tertiary floras, such as the *Genista ephedroides* group (Bacchetta & al., 2011a), which explains the high number of *Genista* species that are exclusive endemics to the Island. Sardinia is also a major centre of diversity and endemism for the genus *Anchusa*, with six allopatric *taxa* occurring in either coastal or mountain habitats of the island (Bacchetta & al., 2008). The genus *Ophrys* has extensively radiated throughout the Mediterranean region (Delforge, 2006) and now encompasses more than 200 species (Gögler & al., 2009). The number of endemic species belonging to this genus is a consequence of the high number of *taxa* that were described mainly in the last 30 years (Delforge, 2006), as a consequence of the difficulties of classifying *Ophrys taxa* into a consensual taxonomic system (Gögler & al., 2009).

The high percentages of chamaephytes and hemicryptophytes detected in this study highlight the pivotal role of the ecological insularity of the mountain massifs for the differentiation of the Sardinian endemic flora (Médail & Quézel, 1997), as confirmed by previous studies (Bacchetta & Pontecorvo, 2005; Bacchetta, 2006). In particular, the antiquity of the limestone mountains and the high incidence of cliffs, have promoted a long evolutionary process in the flora of the Island that has given rise to many specialized chasmophytes (Bacchetta & al., 2007), as previously reported by Fenu & al. (2010) for the Supramontes region. Many of these *taxa* are narrow endemics and most of them make the endemic flora of the Sardinian mountains distinguishable from that of Corsica (Arrigoni, 1983).

The conservation priority ranking allowed the identification of the ten most threatened species, and an integrated conservation approach was initiated for them thanks to the

project funded in 2007 and renewed in 2009 by the “Regione Autonoma della Sardegna”. In particular, their populations have been characterized, and long-term conservation measures were carried out by seed collections that are maintained at the Sardinian Germplasm Bank (BG-SAR). Furthermore, ecological (Bacchetta & al., 2011c; Fenu & al., 2010, 2011, 2012), ecophysiology of seed germination (Cogoni & al., 2012; Mattana & al., 2009, 2010a, b, 2012), as well as population genetic studies (Garrido & al., 2012; Bacchetta & al., data unpublished) have been undertaken with these *taxa*.

In conclusion, the rankings established here provide an updated useful tool at the regional scale for the implementation of *in situ* and *ex situ* conservation measures, according to the criterion of “regional responsibility” elaborated by Gauthier & al. (2010).

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APPENDIX 1

List of taxa with partial categorization and threat total score: **1**, Biological Type; **2**, Dir. Habitat 92/43/EEC; **3**, IUCN National Red List (Conti & al., 1992); **4**, IUCN Regional Red List (Conti & al., 1997); **5**, Scoppola & Spampinato, 2005; **6**, IUCN 2010 (www.iucnredlist.org).

Taxon	Family	1	2	3	4	5	6	Score
<i>Acinos sardous</i> (Asch. & Levier) Arrigoni	Lamiaceae	Ch						16
<i>Alyssum tavolarae</i> Briq.	Brassicaceae	Ch			LR	LR		23.5
<i>Anchusa capellii</i> Moris	Boraginaceae	H			CR	CR		31
<i>Anchusa crispa</i> ssp. <i>maritima</i> (Vals.) Selvi & Bigazzi	Boraginaceae	H			EN	EN		32
<i>Anchusa formosa</i> Selvi, Bigazzi & Bacch.	Boraginaceae	H						24
<i>Anchusa littorea</i> Moris	Boraginaceae	T		V	EN	CR		37
<i>Anchusa montelinasana</i> Angius, Pontecorvo & Selvi ex Bacch., Coppi, Pontecorvo & Selvi	Boraginaceae	H						24
<i>Anchusa sardoa</i> (Illario) Selvi & Bigazzi	Boraginaceae	H						30
<i>Anthyllis hermanniae</i> ssp. <i>ichnusae</i> Brullo et Giusso	Fabaceae	NP						19
<i>Aquilegia barbaricina</i> Arrigoni & E. Nardi	Ranunculaceae	G		E	CR	CR	CR B1ab(ii,iv)+2ab(ii,iv); D	34
<i>Aquilegia nugorensis</i> Arrigoni & E. Nardi	Ranunculaceae	G		V	EN	EN		26
<i>Aquilegia nuragica</i> Arrigoni & E. Nardi	Ranunculaceae	G			CR	CR	CR B1ab(v)+2ab(v); D	34
<i>Armeria morisii</i> Boiss. in A. DC.	Plumbaginaceae	Ch						20
<i>Armeria sardoa</i> ssp. <i>genargentea</i> Arrigoni	Plumbaginaceae	Ch						24
<i>Armeria sardoa</i> Spreng. ssp. <i>sardoa</i>	Plumbaginaceae	H	X					13
<i>Armeria sulcitana</i> Arrigoni	Plumbaginaceae	Ch			LR	LR		20.5
<i>Asperula deficiens</i> Viv.	Rubiaceae	H			LR	LR		27.5
<i>Asperula pumila</i> Moris	Rubiaceae	Ch			LR	LR		23.5
<i>Astragalus genargenteus</i> Moris	Fabaceae	Ch			EN	EN		29
<i>Astragalus gennarii</i> Bacch. & Brullo	Fabaceae	Ch						28
<i>Astragalus maritimus</i> Moris	Fabaceae	H	P	V	CR	CR		33
<i>Astragalus tegulensis</i> Bacch. & Brullo	Fabaceae	Ch						31
<i>Astragalus verrucosus</i> Moris	Fabaceae	H	P	V	CR	CR		33
<i>Bellium crassifolium</i> Moris	Asteraceae	Ch			LR	LR		21.5
<i>Bellium crassifolium</i> var. <i>canescens</i> Gennari	Asteraceae	Ch			LR	LR		27.5
<i>Borago morisiana</i> Bigazzi & Ricceri	Boraginaceae	H			EN	EN		32
<i>Brassica tyrrhena</i> Giotta, Piccitto & Arrigoni	Brassicaceae	Ch						21

APPENDIX 1 (Continuation).

Taxon	Family	1	2	3	4	5	6	Score
<i>Bupthalmum inuloides</i> Moris	Asteraceae	Ch		R	LR	LR		23.5
<i>Campanula forsythii</i> (Arcangeli) Podlech	Campanulaceae	H						17
<i>Centaurea corensis</i> Vals. & Filigh.	Asteraceae	H						31
<i>Centaurea filiformis</i> ssp. <i>ferulacea</i> (Martelli) Arrigoni	Asteraceae	Ch						21
<i>Centaurea filiformis</i> ssp. <i>filiformis</i>	Asteraceae	Ch						20
<i>Centaurea forsythiana</i> Levier	Asteraceae	Ch						0
<i>Centaurea horrida</i> Badarò	Asteraceae	Ch	P	V	VU	VU		28
<i>Centaurea magistrorum</i> Arrigoni & Camarda	Asteraceae	Ch						27
<i>Centranthus amazonum</i> Fridl. & A. Raynal	Valerianaceae	Ch	NP	R	LR	LR	CR B1ab(iii,iv)+2ab(iii,iv); D	34
<i>Cephalaria bigazzii</i> Bacch., Brullo & Giusso	Dipsacaceae	Ch						32
<i>Cephalaria mediterranea</i> (Viv.) Szabò	Dipsacaceae	Ch						18
<i>Cerastium palustre</i> Moris	Caryophyllaceae	T		R	EN	EN		29
<i>Cerastium supramontanum</i> Arrigoni	Caryophyllaceae	H						16
<i>Clinopodium sandalioticum</i> (Bacch. & Brullo) Bacch. & Brullo	Lamiaceae	Ch						29
<i>Colchicum actupii</i> Fridl.	Colchicaceae	G						19
<i>Colchicum verlaqueae</i> Fridl.	Colchicaceae	G						18
<i>Colchium gonarei</i> Camarda	Colchicaceae	G			VU	VU		26
<i>Cymbalaria muelleri</i> (Moris) A. Chev.	Plantaginaceae	Ch						22
<i>Delphinium longipes</i> Moris	Ranunculaceae	H						19
<i>Dianthus genargentus</i> Bacch., Brullo, Casti & Giusso	Caryophyllaceae	Ch						18
<i>Dianthus ichnusae</i> ssp. <i>ichnusae</i>	Caryophyllaceae	Ch						18
<i>Dianthus ichnusae</i> ssp. <i>toddei</i> Bacch., Brullo, Casti & Giusso	Caryophyllaceae	Ch						16
<i>Dianthus insularis</i> Bacch., Brullo, Casti & Giusso	Caryophyllaceae	H						14
<i>Dianthus morisianus</i> Vals.	Caryophyllaceae	Ch		E	VU	VU		34
<i>Dianthus mossanus</i> Bacch. & Brullo	Caryophyllaceae	Ch						16
<i>Dianthus oliastreae</i> Bacch., Brullo, Casti & Giusso	Caryophyllaceae	Ch						14
<i>Dianthus sardous</i> Bacch., Brullo, Casti & Giusso	Caryophyllaceae	Ch						11
<i>Dipsacus valsecchii</i> Camarda	Dipsacaceae	H						15
<i>Echium anchusoides</i> Bacch., Brullo & Selvi	Boraginaceae	H						13
<i>Festuca morisiana</i> Parl.	Poaceae	H						20
<i>Galium glaucophyllum</i> Em. Schmid	Rubiaceae	H			LR	LR		19.5
<i>Galium schmidii</i> Arrigoni	Rubiaceae	Ch						16
<i>Genista arbusensis</i> Vals.	Fabaceae	NP						20
<i>Genista bocchierii</i> Bacch., Feoli Chiapella & Brullo	Fabaceae	P						26
<i>Genista cadasonensis</i> Vals.	Fabaceae	NP						19
<i>Genista insularis</i> ssp. <i>fodinae</i> Bacch., Feoli Chiapella & Brullo	Fabaceae	NP						26
<i>Genista insularis</i> ssp. <i>insularis</i>	Fabaceae	NP						15
<i>Genista morisii</i> Colla	Fabaceae	NP		V	LR	LR		22.5
<i>Genista ovina</i> Bacch., Feoli Chiapella & Brullo	Fabaceae	NP						22
<i>Genista pichi-sermolliana</i> Vals.	Fabaceae	NP						19
<i>Genista sardoa</i> Vals.	Fabaceae	NP						17
<i>Genista sulcitana</i> Vals.	Fabaceae	NP						19
<i>Genista toluensis</i> Vals.	Fabaceae	NP						23
<i>Genista valsecchiae</i> Brullo & De Marco	Fabaceae	NP						18
<i>Helianthemum morisianum</i> Bertol.	Cistaceae	Ch			LR	LR		24.5
<i>Helichrysum montelinasanum</i> Em. Schmid	Asteraceae	Ch		R	LR	LR		23.5
<i>Helichrysum saxatile</i> ssp. <i>morisianum</i> Bacch., Brullo & Mossa	Asteraceae	Ch						25
<i>Helichrysum saxatile</i> ssp. <i>saxatile</i>	Asteraceae	Ch						18
<i>Hieracium iolai</i> Arrigoni	Asteraceae	H			VU	VU		26
<i>Hypericum annulatum</i> Moris	Hypericaceae	H		R	LR	LR		25.5
<i>Hypericum scruglii</i> Bacch., Brullo & Salmeri	Hypericaceae	H						20
<i>Hypochaeris sardoa</i> Bacch., Brullo & Terrasi	Asteraceae	H						18
<i>Iberis integerrima</i> Moris	Brassicaceae	Ch						22
<i>Juncus gussonei</i> Parl.	Juncaceae	G						0
<i>Lactuca longidentata</i> Moris	Asteraceae	H			LR	LR		23.5

APPENDIX 1 (Continuation).

Taxon	Family	1	2	3	4	5	6	Score
<i>Lamyropsis microcephala</i> (Moris) Dittrich & Greuter	Asteraceae	G	P	E	CR	CR	CR B1ab(iii)+2ab(iii)	38
<i>Lavatera triloba</i> ssp. <i>pallescens</i> (Moris) Nyman	Malvaceae	NP						25
<i>Limonium ampuriense</i> Arrigoni & Diana	Plumbaginaceae	Ch		V	LR	LR		23.5
<i>Limonium bosanum</i> Arrigoni & Diana	Plumbaginaceae	Ch		R	LR	LR		23.5
<i>Limonium capitis-eliae</i> Erben	Plumbaginaceae	Ch						24
<i>Limonium capitis-marci</i> Arrigoni & Diana	Plumbaginaceae	Ch		V	EN	EN		27
<i>Limonium caralitanum</i> Erben	Plumbaginaceae	Ch						24
<i>Limonium carisae</i> Erben	Plumbaginaceae	Ch						31
<i>Limonium coralliforme</i> Mayer	Plumbaginaceae	Ch						20
<i>Limonium cornusianum</i> Arrigoni & Diana	Plumbaginaceae	Ch						24
<i>Limonium cunicularium</i> Arrigoni & Diana	Plumbaginaceae	Ch			LR	LR		26.5
<i>Limonium gallurese</i> Arrigoni & Diana	Plumbaginaceae	Ch						27
<i>Limonium hermaeum</i> Pignatti	Plumbaginaceae	Ch						19
<i>Limonium insulare</i> (Bég. & Landi) Arrigoni & Diana	Plumbaginaceae	Ch	P	E	VU	VU		29
<i>Limonium laetum</i> (Nyman) Pignatti	Plumbaginaceae	Ch		V	VU	VU		27
<i>Limonium lausianum</i> Pignatti	Plumbaginaceae	Ch			VU	VU		29
<i>Limonium malfatanicum</i> Erben	Plumbaginaceae	Ch						25
<i>Limonium merxmuelleri</i> Erben	Plumbaginaceae	Ch		V	VU	VU		33
<i>Limonium morisianum</i> Arrigoni	Plumbaginaceae	Ch			LR	LR		21.5
<i>Limonium multifurcatum</i> Erben	Plumbaginaceae	Ch						0
<i>Limonium nymphaeum</i> Erben	Plumbaginaceae	Ch						18
<i>Limonium oristanum</i> Mayer	Plumbaginaceae	Ch						20
<i>Limonium protohermaeum</i> Arrigoni & Diana	Plumbaginaceae	Ch			LR	LR		22.5
<i>Limonium pseudolaetum</i> Arrigoni & Diana	Plumbaginaceae	Ch	P	E	VU	VU		30
<i>Limonium pulviniforme</i> Arrigoni & Diana	Plumbaginaceae	Ch		E	CR	CR		32
<i>Limonium racemosum</i> (Lojac.) Diana	Plumbaginaceae	Ch						25
<i>Limonium retirameum</i> Greuter & Burdet	Plumbaginaceae	Ch						15
<i>Limonium sulcitanum</i> Arrigoni	Plumbaginaceae	Ch						16
<i>Limonium tenuifolium</i> (Bertol. & Moris) Erben	Plumbaginaceae	Ch		R	LR	LR		21.5
<i>Limonium tharrosianum</i> Arrigoni & Diana	Plumbaginaceae	Ch		R	LR	LR		25.5
<i>Limonium tibulatum</i> Pignatti	Plumbaginaceae	Ch						17
<i>Limonium tigulianum</i> Arrigoni & Diana	Plumbaginaceae	Ch						19
<i>Limonium tyrrhenicum</i> Arrigoni & Diana	Plumbaginaceae	Ch						19
<i>Limonium ursanum</i> Erben	Plumbaginaceae	Ch						25
<i>Limonium viniolae</i> Arrigoni & Diana	Plumbaginaceae	Ch						19
<i>Linaria arcusangeli</i> Atzei & Camarda	Plantaginaceae	Ch		R	VU	VU		28
<i>Linum muelleri</i> Moris	Linaceae	Ch	P		EN	EN		27
<i>Malva plazzae</i> (Atzei) Soldano, Banfi & Galasso	Malvaceae	H						20
<i>Medicago intertexta</i> (L.) Mill. var. <i>tuberculata</i> Moris	Fabaceae	T						0
<i>Micromeria cordata</i> (Moris & Bertol.) Moris	Lamiaceae	Ch						18
<i>Narcissus supramontanus</i> ssp. <i>cunicularium</i> Arrigoni	Amaryllidaceae	G						14
<i>Narcissus supramontanus</i> ssp. <i>supramontanus</i>	Amaryllidaceae	G						16
<i>Nepeta foliosa</i> Moris	Lamiaceae	Ch		R	EN	EN		27
<i>Oenanthe lisae</i> Moris	Apiaceae	H						15
<i>Ophrys chestermanii</i> (Wood) Gözl & Reinhard	Orchidaceae	G						20
<i>Ophrys normanii</i> J.J. Wood <i>pro hybr.</i>	Orchidaceae	G						21
<i>Ophrys ortuabis</i> Grasso & Manca	Orchidaceae	G						24
<i>Ophrys panattensis</i> Scrugli, Cogoni & Pessei	Orchidaceae	G						20
<i>Ophrys scolopax</i> ssp. <i>sardoa</i> H. Baumann, Giotta, Lorenz, Künkeke & Piccitto	Orchidaceae	G						0
<i>Ophrys subfusca</i> ssp. <i>liveranii</i> G. Orrù & M.P. Grasso	Orchidaceae	G						26
<i>Orobanche australis</i> Moris ex Bert.	Orobanchaceae	T						14
<i>Orobanche denudata</i> Moris	Orobanchaceae	G						20
<i>Phleum sardoum</i> (Hackel) Hackel in Franchet	Poaceae	T		E	EN	EN		30
<i>Polygala sardoa</i> Chodat	Polygalaceae	H						13

APPENDIX 1 (Continuation).

Taxon	Family	1	2	3	4	5	6	Score
<i>Polygala sinisica</i> Arrigoni	Polygalaceae	Ch		E	CR	CR	CR B1ab(ii)+2ab(ii)	40
<i>Pulicaria vulgaris</i> var. <i>sardoa</i> Fiori	Asteraceae	H						25
<i>Quercus ichnusae</i> Mossa, Bacch. & Brullo	Fagaceae	P						13
<i>Ranunculus cymbalarifolius</i> Balbis ex Moris	Ranunculaceae	H						20
<i>Rhamnus persicifolia</i> Moris	Rhamnaceae	P		V	LR	LR		24.5
<i>Ribes multiflorum</i> ssp. <i>sandalioticum</i> Arrigoni	Grossulariaceae	NP		R	LR	LR		24.5
<i>Ribes sardoum</i> Martelli	Grossulariaceae	NP	P	E	CR	CR	CR B1ab(v)+2ab(v)	41
<i>Romulea bocchierii</i> Frignani & Iriti	Iridaceae	G						24
<i>Rubus arrigonii</i> Camarda	Rosaceae	NP						25
<i>Rubus limbarae</i> Camarda	Rosaceae	NP						23
<i>Rumex suffocatus</i> Moris ex Bertol.	Polygonaceae	H			VU			21
<i>Ruta lamarmorae</i> Bacch., Brullo & Giusso del Galdo	Rutaceae	Ch			LR	LR		26.5
<i>Salix arrigonii</i> Brullo	Salicaceae	P						18
<i>Salvia desoleana</i> Atzei & Picci	Lamiaceae	Ch						27
<i>Santolina insularis</i> (Gennari ex Fiori) Arrigoni	Asteraceae	NP						13
<i>Scorzonera callosa</i> Moris	Asteraceae	H						14
<i>Scrophularia morisii</i> Vals.	Scrophulariaceae	H		R	VU	VU		32
<i>Sedum villosum</i> ssp. <i>glandulosum</i> (Moris) P. Fourn.	Crassulaceae	T			LR	LR		26.5
<i>Senecio sardous</i> (Fiori) Arrigoni	Asteraceae	H						2
<i>Senecio vulgaris</i> var. <i>tyrrhenus</i> Fiori	Asteraceae	T						1
<i>Sesleria insularis</i> ssp. <i>barbaricina</i> Arrigoni	Poaceae	H						11
<i>Sesleria insularis</i> ssp. <i>morisiana</i> Arrigoni	Poaceae	H			LR	LR		22.5
<i>Silene beguinotii</i> Vals.	Caryophyllaceae	T						13
<i>Silene ichnusae</i> Brullo, De Marco & De Marco fil.	Caryophyllaceae	G						28
<i>Silene martinolii</i> Bocchieri & Mulas	Caryophyllaceae	T			LR	LR		23.5
<i>Silene morisiana</i> Bég. & Rav.	Caryophyllaceae	T						18
<i>Silene rosulata</i> ssp. <i>sanctae-therasiae</i> (Jeanm.) Jeanm.	Caryophyllaceae	G		R	VU	VU		28
<i>Silene valsecchiae</i> Bocchieri	Caryophyllaceae	T			LR	LR		23.5
<i>Thesium italicum</i> A. DC. in DC.	Santalaceae	G						15
<i>Verbascum plantagineum</i> Moris	Scrophulariaceae	H						20
<i>Vinca sardoa</i> (Stearn) Pignatti	Apocynaceae	Ch						12
<i>Viola corsica</i> ssp. <i>limbarae</i> Merxm. & Lippert	Violaceae	H						15

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