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IUCN Red List assessment of the Cape Verde endemic flora: towards a global strategy for plant conservation in Macaronesia

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We review the conservation status and threats to the endemic vascular flora of the Cape Verde islands, mostly based on the past two decades of collecting, literature review and herbarium specimens. The application of IUCN Red List criteria and categories using RAMAS software reveals that 78% of the endemic plants are threatened (29.3% Critically Endangered, 41.3% Endangered, 7.6% Vulnerable). Most of these endemics have a limited geographical range, and half of them have Areas of Occupancy and Extents of Occurrence of < 20 and 200 km^2, respectively. Our data show that, over the last two decades, the Cape Verde vascular plants have become more threatened and their conservation status has declined, mostly as a consequence of the increase in exotic species, habitat degradation and human disturbance. This paper presents the first comprehensive IUCN Red List data review for the plants endemic to Cape Verde, thus providing an important step towards the recognition and conservation of its threatened endemic flora at the national and global level. It also fills a knowledge gap, as it represents the first thorough assessment of the conservation status of the entire endemic flora of a Macaronesian archipelago.

ADDITIONAL KEYWORDS: biodiversity hotspot – conservation – oceanic islands – RAMAS Red List – threatened species – vascular flora.

INTRODUCTION

The continuing decline of plant diversity is the focus of major concerns for researchers, conservation managers and policy-makers (e.g. Pimm *et al.*, 2014; Tittensor *et al.*, 2014). Initiatives to conserve the most threatened diversity have developed over recent decades and the IUCN Red List of Threatened Species (www.iucnredlist.org) is widely recognized as the most objective and comprehensive approach for

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evaluating the global conservation status of species and categorizing them according to their estimated risk of extinction (e.g. Mace *et al.*, 2008; Jetz & Freckleton, 2015; Maes *et al.*, 2015).

Assessing the conservation status of endemic plants inhabiting small islands is a key challenge because of their restricted geographical distribution and high vulnerability to threats, mainly due to the loss or alteration of their habitats (Caujapé-Castells *et al.*, 2010). However, the applicability of the IUCN Red List criteria to the exceptionally high number of endemic vascular plants on most oceanic archipelagos remains to be fully assessed. Foremost among such archipelagos is the Macaronesian Region (the Azores, Canary, Madeira and Cape Verde Islands), that harbours *c*. 900 endemic plant species (Bramwell & Caujapé-Castells, 2011). Indeed, the Macaronesian vascular flora is one of the richest in the Mediterranean biodiversity hotspot (Myers *et al*., 2000), hosting over a quarter of the plant species listed in Annex II of the Habitats Directive (Sundseth, 2009), despite representing only 0.2% of the European Union (EU) territory (except Cape Verde, a non-EU country). Some of these endemics have already been assessed, in the context of either national red lists (i.e. the Canary Islands, Banãres *et al*., 2004; Moreno-Saiz, 2008; Moreno-Saiz *et al*., 2015) or the European Red List of Vascular Plants (Bilz *et al*., 2011). However, these reviews only cover some of the endemics from the Macaronesian archipelagos that belong to the EU [the Azores and Madeira (Portugal) and the Canaries (Spain)]. Despite the rigour of these assessments, a comprehensive Red List for the Macaronesian Region is still lacking, which has major implications for the conservation of biodiversity in this hotspot area.

Cape Verde is the only Macaronesian archipelago located in the tropics. Notwithstanding the scientific value of its biota and the existing conservation concerns, the biodiversity of Cape Verde remains poorly understood. The *Flora of the Cape Verde Islands* (Paiva *et al*., 1995–1996; Martins *et al*., 2002) has been an ongoing project for 20 years, with major plant families including Asteraceae, Cyperaceae, Fabaceae, Malvaceae and Poaceae still lacking a comprehensive treatment. Similarly, the preliminary Red List for the flora of the archipelago was published 19 years ago (Leyens & Lobin, 1996), but new endemic taxa have been described or taxonomically rearranged over the last two decades (e.g. Marrero, 2008; Kilian, Galbany-Casals & Oberprieler, 2010; Romeiras *et al*., 2011a; Marrero & Almeida, 2012; Knapp & Vorontsova, 2013). Thus, a comprehensive, updated analysis of the available information regarding population size, distribution and threats to each endemic species is urgently required for the conservation of the unique flora of this archipelago.

In this investigation, we assess the conservation status of all vascular endemic plants from Cape Verde, and we identify the major factors of threat, suggesting conservation measures to be implemented in this archipelago to contribute further to a global conservation strategy for the Macaronesian floras.

MATERIALS AND METHODS

Study area

The Cape Verde archipelago encompasses the southernmost islands of Macaronesia, and is located 1350 km south-west of the Canary Islands and *c*. 560 km west of the African mainland (Fig. 1). This archipelago includes ten islands distributed in three groups: Santo Antão, São Vicente, Santa Luzia and São Nicolau in the north; Santiago, Fogo and Brava in the south; and Sal, Boavista and Maio (the islands with the lowest elevations) in the east (Duarte & Romeiras, 2009). The climate of this archipelago is tropical dry and elevational gradients (details for each island are provided in Fig. 1) and the north-east trade winds are key factors in shaping species distribution (Duarte *et al*., 2008). The vascular plant flora of the Cape Verde archipelago is currently thought to comprise *c*. 740 taxa, 92 of which are endemic (Romeiras *et al*., 2015b).

Inventory of threatened plants

The data on the vascular plants of Cape Verde have been gleaned mostly from the collections compiled in Portugal in the second half of the 19th century, which are housed at the LISC herbarium (IICT/University of Lisbon) and from specimens collected by the authors over the last two decades during several field surveys across the Cape Verde Islands. Additional data were obtained from bibliographic references [*Flora of the Cape Verde Islands* (Paiva *et al*., 1995–1996; Martins *et al*., 2002) and other publications focusing on endemic plants of the area (e.g. Lobin, 1986; Gomes *et al*., 1995; Brochmann *et al*., 1997; Gonçalves, 1999; Duarte, Gomes & Moreira, 2002; Marrero, 2008; Marrero & Almeida, 2012; Knapp & Vorontsova, 2013)]. Data concerning species ecology and distribution in the islands, elevation, collectors' names and dates of collection were included in a database that contains *c*. 4700 individual records; whenever possible, the geographical coordinates of the accessions were also considered (only specimens collected after 1955 could be georeferenced, due to insufficient location information provided on historical specimen labels). A total of 4583 specimens were georeferenced using 1:25 000 and 1:100 000 cartographic maps and the data were compiled in ArcGIS Arcinfo ver. 10.0 (ESRI, 2011).

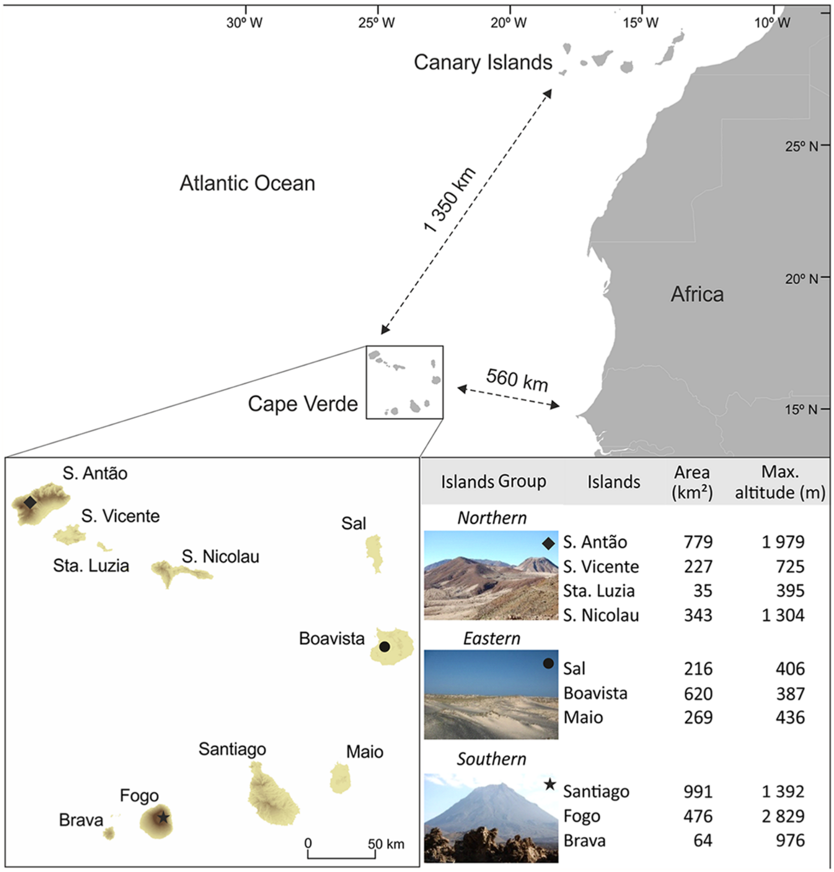


Figure 1. Cape Verde archipelago: geographical location (top), map of the islands and some geophysical features (bottom). Photographs: Santo Antão (Tope de Coroa), Boavista (Sal Rei) and Fogo (Pico do Fogo) (photographs M.M.R. and J.C.C.).

RED LIST ASSESSMENTS

The conservation status of the Cape Verde endemic flora was evaluated following the IUCN Red List categories, so that each listed species could be classified as Extinct (EX), threatened [i.e. Critically Endangered (CR), Endangered (EN) or Vulnerable (VU)], Near Threatened (NT), Least Concern (LC) or Data Deficient (DD) for species that are poorly known. For the five quantitative criteria (A–E), which were used to evaluate each taxon, we followed the IUCN Red List Categories and Criteria guidelines (for further details see: http://www.iucnredlist.org/documents/RedListGuidelines.pdf; IUCN Standards and Petitions Subcommittee, 2014). Criterion B (i.e. restricted distribution and decline, fluctuations and/or fragmentation) and criterion D (i.e. very small or restricted populations) were the most commonly used. The population declines were checked through consultations with local experts and the authors' field knowledge acquired during successive surveys of the Cape Verde archipelago since the mid-1990s.

We calculated the following parameters for each endemic species: number of subpopulations (quantified by the number of islands of occurrence of a taxon); number of locations (corresponding to the number of geographically or ecologically distinct areas of occurrence); extent of occurrence (EOO); and area of occupancy (AOO). The parameter EOO was estimated using the minimum convex polygon method, which determines the area contained within the shortest continuous imaginary boundary that can be drawn to encompass all the occurrences of a taxon, whereas AOO was calculated by adding the number of cells occupied by individuals in a grid of 1 × 1 km. For both calculations we used the GeoCAT software (Bachman *et al.*, 2011). Evaluation of the conservation status was made using the RAMAS Red List software v.2.0 (Akçakaya, Root & Ferson, 2001), which was successfully applied to the Cape Verde IUCN extinction risk assessment of reptiles (Vasconcelos *et al.*, 2013). RAMAS assigns each taxon to Red List categories according to the IUCN Red List Criteria and explicitly handles data uncertainty (Akçakaya *et al.*, 2000). To avoid inconsistency and ambiguity in the evaluations, different attitudes towards uncertainties can be incorporated by adopting a precautionary or evidentiary attitude to risk [risk tolerance (RT)]. This parameter ranges from 0 for risk-averse, precautionary attitude to 1 for risk-prone, evidentiary attitude (Akçakaya *et al.*, 2000). An evidentiary attitude (RT = 0.6) was applied, as recommended by Romeiras *et al.* (2015a) for small islands.

Finally, major threats for each taxon were assessed using a standardized list (http://www.iucnredlist.org/technical-documents/classification-schemes/threats-classification-scheme; IUCN Standards and Petitions Subcommittee, 2014) implemented in RAMAS and were evaluated based on information gathered during ecological surveys and published data.

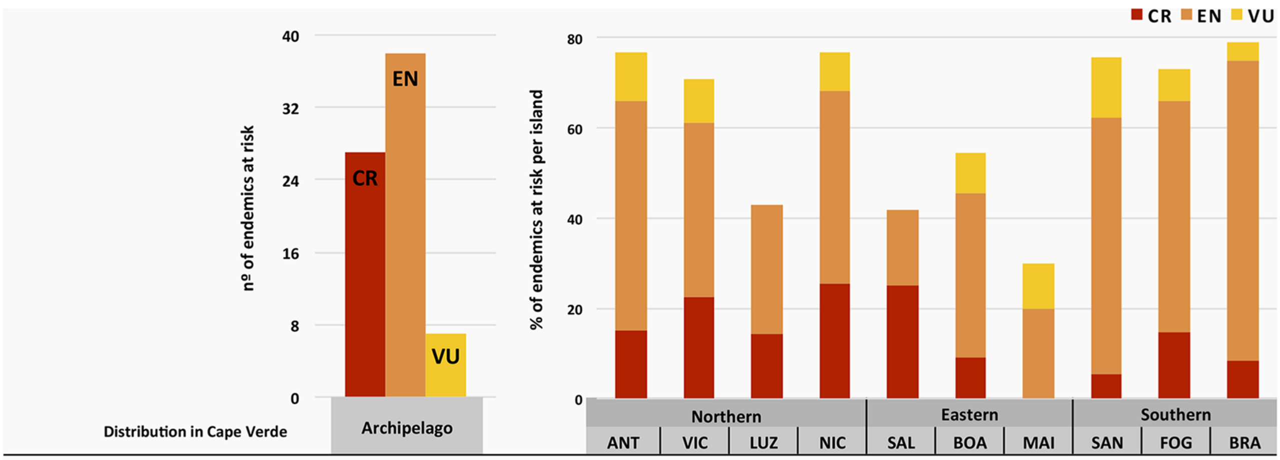
RESULTS

Status of threatened plant species in Cape Verde

Our results revealed that 78% of the assessed endemics (92 taxa) were listed in threat categories: 27 (29.3%) as CR, 38 (41.3%) as EN and seven (7.6%) as VU (Fig. 2). Eight (8.7%), one (1.1%) and five (5.4%) taxa were classified as NT, LC and DD, respectively (Table 1). Six taxa (6.5%) belonging to *Lotus* L. (Fabaceae) were Not Evaluated (NE), given the wide morphological diversity and considerable taxonomic uncertainties that hinder the assignment of collected samples to a particular species. In addition to the 92 endemics assessed, two species were classified as Extinct (EX) (*Stachytarpheta fallax* A.E.Gonç. and *Habenaria petromedusa* Webb), as they are known only from the type specimens collected in the 18th century by J. S. Feijó.

Presently, the endemic flora of Cape Verde includes a total of 27 families (see Table 1) and the species-rich families include Apiaceae, Asteraceae, Boraginaceae, Brassicaceae, Fabaceae, Plantaginaceae and Plumbaginaceae. These seven families include > 60% of the total endemic flora, of which 85% are threatened species (CR, EN or VU) (Fig. 3). Most of the taxa in the largest radiations (e.g. *Conyza* L.; *Diplotaxis* DC.; *Echium* L.; *Limonium* Mill.; *Tornabenea* Parl. ex Webb) were classified in the most threatened categories (CR and EN) and only one taxon was classified as VU (*Diplotaxis antoniensis* Rustan).

Criterion B (geographical range) was the most frequently used for the categorization of threat (73.3% taxa) (Table 1). Most of the endemics have a limited geographical range, with half of them having AOO and EOO < 20 and < 200 km^2, respectively. Approximately 27% of the taxa assessed simultaneously have an AOO and an EOO ≤ 10 and ≤ 100 km^2, respectively; among these, 18 are single-island endemics (SIEs). The largest AOO and/or EOO values (Table 1) are displayed by *Euphorbia tuckeyana* Steud. ex Webb, *Cynanchum daltonii* (Decne. ex Webb) Liede & Meve, *Paronychia illecebroides* Webb and *Forsskaolea procridifolia* Webb; these species occur on seven or more islands and most of them were evaluated as NT, except *C. daltonii* (LC). The smallest AOO and EOO



	Archipelago	ANT	VIC	LUZ	NIC	SAL	BOA	MAI	SAN	FOG	BRA
Nº of threatened taxa (CR, EN, VU)	72	36	22	3	36	5	6	3	28	30	19
Total number of endemics	92	47	31	7	47	12	11	10	37	41	24
% of threatened taxa (CR, EN, VU)	78%	76%	71%	43%	77%	42%	55%	30%	76%	73%	79%

Figure 2. Distribution of Cape Verde endemic species by threatened categories [Critically Endangered (CR), Endangered (EN), Vulnerable (VU)] in the archipelago (left) and in each island (right). Island abbreviations: Santo Antão (ANT), São Vicente (VIC), Santa Luzia (LUZ), São Nicolau (NIC) (Northern Group); Sal (SAL), Boavista (BOA), Maio (MAI) (Eastern Group); Santiago (SAN), Fogo (FOG), Brava (BRA) (Southern Group).

Table 1. Some parameters used for the assessment of conservation status of the Cape Verde endemic plant taxa and Red List categories and criteria

Family	Taxon	Islands*	Locations†	AOO (km²)	EOO (km²)	Red List 1996‡	Red List 2015	Criteria 2015
Crassulaceae	*Aeonium gorgoneum* J.A.Schmidt	3	5	38	224.26	LR	EN	B1ab(ii,iii)+2ab(ii,iii)
Poaceae	*Aristida cardosoi* Cout.	10 (9)	22	53	848.37	NE	NT	
Asteraceae	*Artemisia gorgonum* Webb	3	7	37	260.40	VU	VU	B1ab(ii,iv)+2ab(ii,iv)
Asparagaceae	*Asparagus squarrosus* J.A.Schmidt	7	20	50	924.03	LR	NT	
Asteraceae	*Asteriscus daltonii* (Webb) Walp. subsp. *daltonii*	1	2	11	66.73	EN	EN	D
Asteraceae	*Asteriscus daltonii* (Webb) Walp. subsp. *vogelii* (Webb) Greuter	7	20	91	1151.37	LR	NT	
Asteraceae	*Asteriscus smithii* (Webb) Walp.	1	1	4	4.00	EN	CR	B1ab(iii)+2ab(iii)
Poaceae	*Brachiaria lata* (Schumach.) C.E.Hubb. subsp. *caboverdeana* Conert & C.Köhler	4	8	41	569.44	VU	VU	B1ab(iii)+2ab(iii)
Campanulaceae	*Campanula bravensis* (Bolle) A.Chev.	3	5	44	224.99	LR	EN	B1ab(ii,iv)+2ab(ii,iv)
Campanulaceae	*Campanula jacobaea* C.Sm. ex Webb	4	7	74	514.36	NE	VU	B1ab(ii)+2ab(ii)
Plantaginaceae	*Campylanthus glaber* Benth. subsp. *glaber*	6	18	66	1001.20	VU	EN	B1ab(ii)+2ab(ii)
Plantaginaceae	*Campylanthus glaber* Benth. subsp. *spathulatus* (A.Chev.) Brochmann, N.Kilian, Lobin & Rustan	1	2	11	143.13	NE	EN	B1ab(ii)+2ab(ii); D
Cyperaceae	*Carex antoniensis* A.Chev.	1	1	3	3.00	CR	CR	B1ab(ii)+2ab(ii); D
Cyperaceae	*Carex paniculata* L. subsp. *hansenii* Lewej. & Lobin	1	1	3	3.00	CR	CR	B1ab(ii)+2ab(ii); D
Gentianaceae	*Centaurium tenuiflorum* (Hoffmanns. & Link) Fritsch subsp. *viridense* (Bolle) O.Erikss., A.Hansen & Sunding	3	5	11	207.63	NE	CR	D
Asteraceae	*Conyza feae* (Beg.) Wild	6 (5)	9	76	617.39	EN	EN	B1ab(ii,iv)+2ab(ii,iv)
Asteraceae	*Conyza pannosa* Webb	5	7	22	166.08	EN	EN	B1ab(ii,iv)+2ab(ii,iv)
Asteraceae	*Conyza schlechtendalii* Bolle	1	1	3	3.00	CR	CR	D
Asteraceae	*Conyza varia* (Webb) Wild	5	9	45	258.96	EN	EN	B1ab(ii,iv)+2ab(ii,iv)
Apocynaceae	*Cynanchum daltonii* (Decne. ex Webb) Liede & Meve	7	14	105	1534.62	NE	LC	None
Brassicaceae	*Diplotaxis antoniensis* Rustan	1	3	16	187.84	NE	VU	D1+2
Brassicaceae	*Diplotaxis glauca* (Schmidt) O.E.Schulz	2	3	10	103.56	VU	CR	D
Brassicaceae	*Diplotaxis gorgadensis* Rustan subsp. *brochmannii* Rustan	1	2	3	3.00	VU	CR	B1ab(ii)+2ab(ii)
Brassicaceae	*Diplotaxis gorgadensis* Rustan subsp. *gorgadensis*	1	2	12	171.77	NE	EN	B1ab(ii)+2ab(ii)
Brassicaceae	*Diplotaxis gracilis* (Webb) O.E.Schulz	1	3	10	146.12	VU	EN	B1ab(iii)+2ab(iii)
Brassicaceae	*Diplotaxis hirta* (A.Chev.) Rustan & L.Borgen	1	4	25	212.58	NE	EN	B1ab(ii)+2ab(ii)
Brassicaceae	*Diplotaxis sundingii* Rustan	1	2	3	3.00	R	CR	B1ab(ii)+2ab(ii)
Brassicaceae	*Diplotaxis varia* Rustan	2	4	25	214.53	I	EN	B1ab(ii)+2ab(ii)
Brassicaceae	*Diplotaxis vogelli* (Webb) Cout.	1	2	6	43.61	I	CR	B1ab(ii)+2ab(ii)
Asparagaceae	*Dracaena draco* (L.) L. subsp. *caboverdeana* Marrero Rodr. & R.S.Almeida	6 (3)	4	16	53.00	NE	CR	B1ab(ii,iv)
Polypodiaceae	*Dryopteris gorgonea* J.P.Roux	3	–	3	3.00	NE	DD	
Boraginaceae	*Echium hypertropicum* Webb	2	3	34	222.65	EN	EN	B1ab(ii)+2ab(ii)

Table 1. *Continued*

Family	Taxon	Islands*	Locations†	AOO (km²)	EOO (km²)	Red List 1996‡	Red List 2015	Criteria 2015
Boraginaceae	*Echium stenosiphon* Webb subsp. *glabrescens* (Pett.) Romeiras & Maria C.Duarte	1	2	29	105.60	LR	EN	B1ab(ii)+2ab(ii)
Boraginaceae	*Echium stenosiphon* Webb subsp. *lindbergii* (Pett.) Bramwell	1	2	42	284.83	I	EN	B1ab(ii)+2ab(ii)
Boraginaceae	*Echium stenosiphon* Webb subsp. *stenosiphon*	1	2	14	59.48	VU	CR	B1ab(ii)
Boraginaceae	*Echium vulcanorum* A.Chev.	1	3	21	121.75	EN	EN	B1ab(ii)+2ab(ii)
Poaceae	*Eragrostis conertii* Lobin	5	8	14	71.60	R	DD	
Brassicaceae	*Erysimum caboverdeanum* (A.Chev.) Sunding	1	2	13	50.03	EN	CR	B1ab(ii)
Euphorbiaceae	*Euphorbia tuckeyana* Steud. ex Webb	9 (8)	16	108	1145.26	VU	NT	
Zygophyllaceae	*Fagonia mayana* Schlecht.	3	4	11	91.91	NE	DD	
Urticaceae	*Forsskaolea procridifolia* Webb	9	21	93	1569.67	NE	NT	
Frankeniaceae	*Frankenia ericifolia* C.Sm. ex DC. subsp. *caboverdeana* Brochmann, Lobin & Sunding	3	6	20	590.48	NE	EN	B1ab(ii)+2ab(ii)
Frankeniaceae	*Frankenia ericifolia* C.Sm. ex DC. subsp. *montana* Brochmann, Lobin & Sunding	1	2	6	8.19	EN	CR	B1ab(iii)+2ab(iii)
Plantaginaceae	*Globularia amygdalifolia* Webb	5	9	50	378.28	VU	EN	B1ab(ii)+2ab(ii)
Orchidaceae	*Habenaria petromedusa* Webb	–	–			NE	EX	
Cistaceae	*Helianthemum gorgoneum* Webb	4	6	43	490.61	NE	EN	B1ab(ii,iv)+2ab(ii,iv)
Asteraceae	*Helichrysum nicolai* N.Kilian, Galbany & Oberpr.	1	1	2	2.00	NE	CR	D
Plantaginaceae	*Kickxia elegans* (G.Forst.) D.A.Sutton subsp. *dichondrifolia* (Benth.) Rustan & Brochmann	4	7	24	290.46	NE	EN	B1ab(ii,iv)+2ab(ii,iv)
Plantaginaceae	*Kickxia elegans* (G. Forst.) D.A.Sutton subsp. *elegans*	9 (8)	13	56	902.06	NE	EN	B1ab(iv)+2ab(iv)
Plantaginaceae	*Kickxia elegans* (G. Forst.) D.A.Sutton subsp. *webbiana* (Sunding) Rustan & Brochmann	1	1	14	132.63	NE	EN	B1ab(ii)+2ab(ii)
Asteraceae	*Launaea gorgadensis* (Bolle) N.Kilian	3	7	15	26.29	LR	CR	B1ab(iii)
Asteraceae	*Launaea picridioides* (Webb) B.L.Rob.	3	6	56	667.82	LR	VU	B1ab(ii)+2ab(ii)
Asteraceae	*Launaea thalassica* N.Kilian, Brochmann & Rustan	1	2	9	18.36	R	CR	B1ab(iii)+2ab(iii)
Lamiaceae	*Lavandula rotundifolia* Benth.	5	14	95	1060.16	LR	NT	
Plumbaginaceae	*Limonium braunii* (Bolle) A.Chev.	4	6	24	244.98	NE	EN	B1ab(ii)+2ab(ii)
Plumbaginaceae	*Limonium brunneri* Kuntze	3	5	13	59.06	LR	CR	B1ab(ii,iii,iv)
Plumbaginaceae	*Limonium jovibarba* Kuntze	2	2	10	15.58	R	CR	B1ab(ii); D
Plumbaginaceae	*Limonium lobinii* N.Kilian & Leyens	1	1	10	13.58	R	CR	B1ab(ii); D
Plumbaginaceae	*Limonium sundingii* Leyens, Lobin, N.Kilian & Erben	1	1	2	2.00	R	CR	D
Brassicaceae	*Lobularia canariensis* (DC.) L.Borgen subsp. *fruticosa* (Webb) L.Borgen	5	8	33	192.69	I	EN	B1ab(ii,iv)+2ab(ii,iv)
Brassicaceae	*Lobularia canariensis* (DC.) L.Borgen subsp. *spathulata* (J.A.Schmidt) L.Borgen	2	4	11	26.29	I	CR	B1ab(iii)
Fabaceae	*Lotus alianus* J.H.Kirkbr.	2	–	1	1.00	NE	NE	
Fabaceae	*Lotus arborescens* Lowe ex Cout.	1	–	4	4.00	R	NE	

Table 1. *Continued*

Family	Taxon	Islands*	Locations†	AOO (km²)	EOO (km²)	Red List 1996‡	Red List 2015	Criteria 2015
Fabaceae	*Lotus brunneri* Webb	5	–	33	354.46	LR	NE	
Fabaceae	*Lotus jacobaeus* L.	2	–	26	305.68	NE	NE	
Fabaceae	*Lotus latifolius* Brand	1	–	24	283.06	NE	NE	
Fabaceae	*Lotus purpureus* Webb	7	–	58	514.75	NE	NE	
Lamiaceae	*Micromeria forbesii* Benth.	5	7	52	366.77	I	EN	B1ab(ii,iv)+2ab(ii,iv)
Papaveraceae	*Papaver gorgoneum* Cout. subsp. *gorgoneum*	2	3	8	39.96	VU	CR	B1ab(ii)+2ab(ii)
Papaveraceae	*Papaver gorgoneum* Cout. subsp. *theresias* Kadereit & Lobin	1	1	5	14.73	NE	CR	B1ab(ii)+2ab(ii); D
Caryophyllaceae	*Paronychia illecebroides* Webb	8 (7)	23	103	1518.93	LR	NT	
Apocynaceae	*Periploca chevalieri* Browicz	6	13	61	553.66	EN	EN	B1ab(ii)+2ab(ii)
Asteraceae	*Phagnalon melanoleucum* Webb	5	8	46	255.60	NE	EN	B1ab(ii)+2ab(ii)
Arecaceae	*Phoenix atlantica* A.Chev.	4	5	17	317.03	NE	EN	B1ab(iii)+2ab(iii)
Caryophyllaceae	*Polycarpaea gayi* Webb	6	13	93	920.38	LR	NT	
Asteraceae	*Pulicaria burchardii* Hutch. subsp. *longifolia* E.Gamal-Eldin	1	1	2	2.00	NE	DD	
Asteraceae	*Pulicaria diffusa* (Shuttlew. ex S.Brunner) Pett.	5 (4)	6	20	344.42	VU	EN	B1ab(iv)+2ab(iv)
Sapotaceae	*Sideroxylon marginatum* (Decne. ex Webb) Cout.	8 (5)	7	24	456.31	EN	EN	B1ab(ii)+2ab(ii)
Solanaceae	*Solanum rigidum* Lam.	7 (5)	8	17	396.29	NE	VU	B1ab(ii)+2ab(ii)
Asteraceae	*Sonchus daltonii* Webb	5	9	44	261.98	I	EN	B1ab(iv)+2ab(iv)
Poaceae	*Sporobolus minutus* Link subsp. *confertus* (J.A.Schmidt) Lobin, N.Kilian & Leyens	2	2	4	4.00	R	DD	
Verbenaceae	*Stachytarpheta fallax* A.E.Gonç.	–	–	–	–	NE	EX	
Fabaceae	*Teline stenopetala* (Webb & Berthel.) Webb & Berthel. subsp. *santoantaoi* Marrero Rodr.	1	1	1	1.00	NE	CR	D
Asteraceae	*Tolpis farinulosa* (Webb) J.A.Schmidt	5	9	28	192.45	I	EN	B1ab(ii)+2ab(ii)
Apiaceae	*Tornabenea annua* Bég. ex A.Chev.	1	2	28	237.96	VU	EN	B1ab(ii)+2ab(ii)
Apiaceae	*Tornabenea bischoffii* J.A.Schmidt	1	3	20	402.25	VU	EN	B1ab(ii)+2ab(ii)
Apiaceae	*Tornabenea humilis* Lobin & K.H.Schmidt	1	3	13	207.73	NE	EN	B1ab(ii)+2ab(ii)
Apiaceae	*Tornabenea insularis* Parl. ex Webb	3	5	22	84.18	LR	EN	D
Apiaceae	*Tornabenea ribeirensis* K.H.Schmidt & Lobin	1	1	5	10.46	NE	CR	B1ab(iii)+2ab(iii)
Apiaceae	*Tornabenea tenuissima* (A.Chev.) A.Hansen & Sunding	1	2	8	55.94	VU	CR	B1ab(ii)+2ab(ii)
Crassulaceae	*Umbilicus schmidtii* Bolle	4	6	23	100.43	R	EN	B1ab(ii)+2ab(ii)
Scrophulariaceae	*Verbascum capitis-viridis* Hub.-Mor.	6 (3)	7	57	582.22	VU	VU	B1ab(ii,iii)+2ab(ii,iii)
Scrophulariaceae	*Verbascum cystolithicum* (Pett.) Hub.-Mor.	1	3	23	158.42	NE	EN	B1ab(ii)+2ab(ii)
Solanaceae	*Withania chevalieri* A.E.Gonç.	4 (3)	3	6	6.00	NE	CR	B1ab(ii)+2ab(ii)

*Number of islands where the species is known. In parentheses: islands for which data was obtained, when different from the known distribution.

†Main locations corresponds to the number of geographically or ecologically distinct areas of occurrence. Location data are not provided for the species classified as Extinct (EX) and Not Evaluated (NE).

‡Red List categories according to Leyens & Lobin (1996).

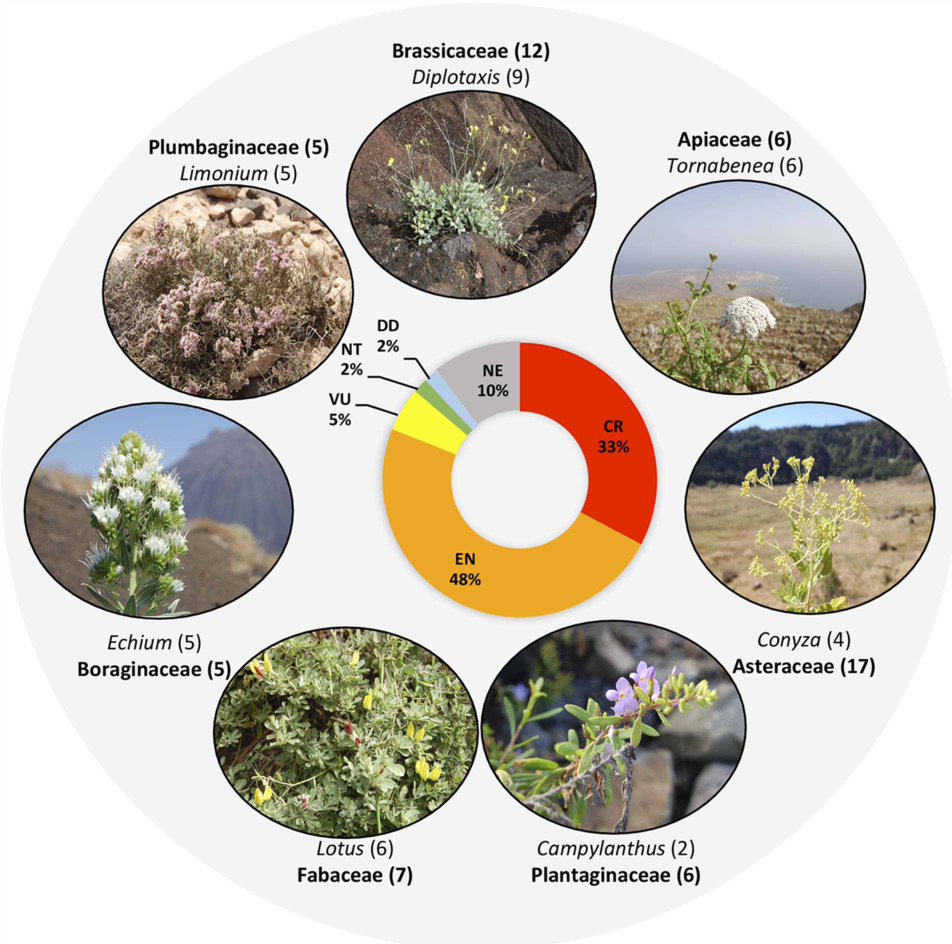


Figure 3. Families represented by five or more endemic taxa: major plant lineages with the corresponding number of taxa in parentheses (outer circles), and distribution of these 58 taxa by the Red List Categories (inner chart) (photographs M.M.R.).

values were for *Teline stenopetala* (Webb & Berthel.) Webb & Berthel. subsp. *santoantaoi* Marrero Rodr. (CR). For CR species, AOO values ranged mainly from 3.0 to 10.5 km^2 and for VU species AOO ranged from 27.0 to 56.5 km^2, whereas EOO values were considerably higher, between 3.0 and 46.8 km^2 for CR species and between 328.3 and 575.8 km^2 for VU species (Supporting Information Fig. S1).

The distribution of threatened species (Fig. 2) shows that the northern and southern mountain island groups have the highest percentages (ranging from 71% in São Vicente to 79.2% in Brava), because these island groups harbour most of the SIEs, which have restricted AOO and EOO, thus potentially qualifying in the highest threat categories (i.e. CR) under IUCN criterion B (see Table 1). Most of the species distributed in the eastern islands have a large EOO, because they are quite widespread in the archipelago. Nonetheless, these results correspond to global assessments in the archipelago and the category of particular species for each island may be different, depending on the number of populations and the number and intensity of threats that may affect their survival.

Red List changes in the last two decades

A comparison between the current conservation assessment of the endemic taxa and the preliminary one carried out in 1996 (Table 1) shows that, overall, the Cape Verde plants are more threatened and their conservation status has declined over the last two decades (see Fig. S2). Although about one-quarter of the endemic vascular flora was not evaluated by Leyens & Lobin (1996), it is noted that the three taxa previous classified as CR (*Conyza schlechtendalii* Bolle, *Carex antoniensis* A.Chev. and *C. paniculata* L. subsp. *hansenii* Lewej. & Lobin) still remain in this threat category. Recent field surveys have revealed

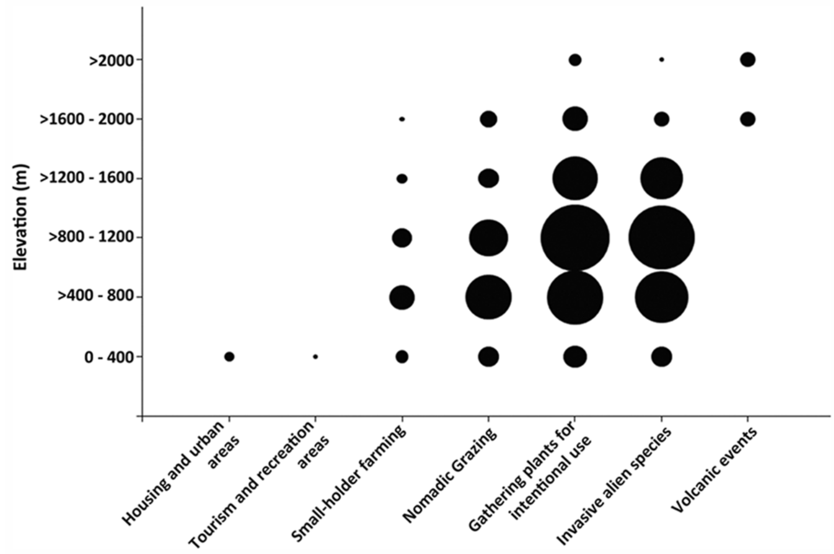


Figure 4. Incidence along elevation classes of the main threats to the Cape Verdean endemic plants. The size of the circles is proportional to the number of species affected in the corresponding elevation class. Classification of threats as defined by IUCN (http://www.iucnredlist.org/technical-documents/classification-schemes/threats-classification-scheme).

that *C. schlechtendalii* is restricted to a small population on São Nicolau, and the two *Carex* taxa are only found as small populations on Santo Antão (Ribeira do Paul). Moreover, the categories 'Undetermined' and 'Rare' applied by Leyens & Lobin (1996) are no longer considered by the IUCN (for further details see information in Fig. S2) and almost all the taxa under these categories are now classified as CR or EN due to the small fragmented and restricted populations. On the other hand, of the 15 taxa assessed as VU in 1996, only *Euphorbia tuckeyana* was downlisted from VU to NT due to its widespread distribution in the archipelago and the fact that some populations with a significant number of individuals were recently found, namely in Tope de Coroa on Santo Antão.

Despite our results pointing to an increase in extinction risk during the last two decades, recent field surveys allowed us to rediscover several species reported as extinct by Leyens & Lobin (1996). A first example is *Diplotaxis glauca* (Schmidt) O.E.Schulz, only recorded in Boavista in 1851 (leg. Schmidt; type collection), and considered extinct by Brochmann *et al*. (1997) until it was collected in 2013 by one of us (M.C.D.). Also during recent fieldwork, scattered trees of *Dracaena draco* (L.) L. subsp. *caboverdeana* Marrero Rodr. & R.S.Almeida were found in Santiago and Brava, thus supporting the contention by Marrero & Almeida (2012) that this species currently only has natural populations on Santo Antão, São Nicolau and Fogo, but also grows sub-spontaneously on Santiago and Brava. Finally, Marrero & Almeida Pérez (2013) reported the re-discovery on Brava of the native species *Eulophia guineensis* Lindl. (Orchidaceae).

Main threats

Following the IUCN Threats Classification Scheme (Version 3.2), the most pervasive threats reported in Cape Verde were, in decreasing order of importance (Fig. 4): (1) gathering plants for intentional use, (2) invasive alien species and (3) nomadic grazing. Natural disasters, specifically recent volcanic events (with the most recent eruption occurring in 2014), have had an impact on species that occur above 1600 m a.s.l. on Fogo, whereas tourism and recreation areas are especially significant for the taxa distributed in the lowland coastal areas of the eastern islands. Most of the threats were recorded between 400 and 1200 m a.s.l. and were especially associated with strong anthropic disturbances, as mentioned earlier (Fig. 4).

DISCUSSION

Our study presents the most comprehensive Red Data List for the endemic vascular plants of Cape Verde, thus providing an important instrument towards the recognition and conservation of the threatened flora of this archipelago at both national and global levels. Internationally, the conservation of the endemic Cape Verde flora is of great importance; according to a recent review by Caujapé-Castells *et al*. (2010), its flora is one of the most threatened in the Macaronesian archipelagos. Our results, pointing to 78% of threatened taxa, unequivocally confirm this position, followed by Azores, Madeira and the Canary Islands with 63, 49 and 30% of threatened taxa, respectively (Caujapé-Castells *et al.*, 2010).

A high extinction risk was recently documented in the Red List of the endemic monocotyledons of Morocco (Rankou *et al.*, 2015), an African country mainly characterized by a semi-arid climate, like Cape Verde. In both cases, > 70% of the assessed endemic flora was classified in high-risk categories (CR or EN). Unlike Morocco, the higher vulnerability of the Cape Verde endemic flora could be mainly explained by its tropical dry climate and by the increasing aridity that affects the islands, especially at lower elevations, which could have led to population reductions and restrictions on distribution ranges of the taxa.

Nevertheless, the high proportion of threatened species revealed in our study might also be influenced by some drawbacks during the conservation assessments, mostly because the sampling efforts were not uniformly distributed in all Cape Verde regions/islands and species may have larger distributions than recognized. Thus, the inadequacies in taxonomic and distributional data and the so-called Linnean and Wallacean shortfalls (Whittaker *et al.*, 2005), which are recognized to increase in more remote areas such as oceanic islands (Ladle & Whittaker, 2011), constitute two of the most pressing problems for the thorough conservation of the Cape Verde flora. To counteract these shortfalls, it is essential to study different biodiversity units, which can range from genes to landscapes. Therefore, the conservation of intraspecific genetic diversity at the archipelago scale and the protection of species and habitats will be of particular importance for underpinning conservation programmes. Recently, studies focusing on the Macaronesian flora (García-Verdugo *et al.*, 2015; Patiño *et al.*, 2015; Romeiras *et al.*, 2015b) revealed that some plant lineages are genetically more diverse than previously recognized. These findings further highlight the need to conserve insular populations, as many of them are not as 'genetically depauperate' as previously thought (García-Verdugo *et al.*, 2015). Nevertheless, the concrete application of genetic data to the design of protected areas at the archipelago scale remains largely unexplored in insular biodiversity hotspots (Buerki *et al.*, 2015; but see Jaén-Molina, 2014).

The present global assessment of the conservation status of Cape Verde endemic vascular plants shows that more than three-quarters of species are classified in one of the threat categories (i.e. CR, EN and VU) under IUCN Red List standards. A further five species are listed as DD, and it is likely that these endemic taxa are also threatened. As suggested in these situations (Akçakaya *et al.*, 2000), our recommendation is that Cape Verde DD species should be assigned to the same degree of protection as threatened species until more information is available. Such a scenario would add new species to the threat categories and have consequences for conservation prioritization. Additionally, our results illustrate the importance of an accurate taxonomy prior to a conservation assessment in insular endemic plants, thus reinforcing Mace's (2004) opinion that more collaboration is needed among conservation biologists and high-profile taxonomists. This seems particularly relevant for *Lotus*, which was not evaluated due to the wide morphological diversity that hinders clear taxonomic delimitation of the species.

The IUCN Red List system has been refined over the 20 years since the first Cape Verde plant Red List was published; given the significant differences in the assessment methodologies, we need to use considerable caution when comparing our results with the previous list of Leyens & Lobin (1996). Although our data point towards an increase in extinction risk during the last two decades, this result might be also related to: (1) the use of new more accurate data which generate more realistic assessments; (2) the application of IUCN available tools (e.g. the RAMAS software) instead of 'expert opinion'; (3) the inclusion of new analyses on the threats impacting the Cape Verde plants; (4) the enlargement of the assessment to all the endemic flora, with a considerable number of taxa being categorized for the first time and assigned to threat categories; and (5) changes in the taxonomy of some groups that have produced an upward surge of critically endangered species due to taxonomic splitting. This last factor may have considerable conservation implications as some clades were divided (e.g. *Echium stenosiphon* Webb *s.l.*, see Romeiras *et al.*, 2011a), with the new taxa having more restricted AOO and EOO.

The high percentage of threatened taxa in Cape Verde is alarming and, as in other insular ecosystems (e.g. Caujapé-Castells *et al.*, 2010; Kueffer *et al.*, 2010), habitat degradation, human disturbance (e.g. intentional use for agriculture or traditional uses; Romeiras *et al.*, 2011b) and introduction of exotic species since the beginning of the islands' colonization (Romeiras *et al.*, 2014) are among the main threats. During the fieldwork, several endemic species were commonly found associated with the invasive exotic species *Furcraea foetida* (L.) Haw. (Asparagaceae) and *Lantana camara* L. (Verbenaceae), which are naturalized in the archipelago and usually appear in zones of medium to high elevation between 400 and 1100 m, where most of the endemic species occur. Furthermore, the recent volcanic activity on Fogo led to population extinctions, particularly among the SIEs *Echium vulcanorum* A.Chev., *Erysimum caboverdeanum* (A.Chev.) Sunding and *Verbascum cystolithicum* (Pett.) Hub.-Mor. that mainly occur above 1600 m in Chã das Caldeiras.

In general, these threats have a negative impact on the Cape Verde flora: most endemics have a limited geographical range (in terms of both AOO and EOO), thus being more susceptible to extinction. To prevent extinction, several conservation actions were undertaken in the last 12 years by the Cape Verde authorities, in particular establishing a system of Protected Areas (PAs) to safeguard the natural heritage of the archipelago (MAAP, 2004). Presently, the national PA network encompasses 47 different areas, totalling *c.* 63 067 ha of land area (see Rede de Áreas Protegidas de Cabo Verde, 2015) that includes four main protection categories: Nature Reserve, Natural Park, Natural Monument and Protected Landscape. Among these, the Natural Parks encompass sensitive areas for biodiversity conservation, where the majority of the endemic plants occur (e.g. Tope de Coroa, Santo Antão; Monte Gordo, São Nicolau; Monte Verde, São Vicente; Serra da Malagueta, Santiago; Chã das Caldeiras, Fogo). These National Parks are found in mountain regions of the northern and southern island groups, where most of the endemics occur as small and isolated populations, mostly in the north-eastern exposed slopes above 400 m. In these mountain areas, greater floristic affinities are shared with the other Macaronesian archipelagos, especially with the Canaries and Madeira. Among these affinities we find several endemics that belong to some of the largest plant radiations in Macaronesia and worldwide (e.g. *Aeonium* Webb & Berthel., *Echium* L., *Euphorbia* L., *Micromeria* Benth., *Sonchus* L., *Tolpis* Adans.), thus posing a compelling need to conserve the entire extent of their natural ranges as a key objective of the informed conservation of the Macaronesian biodiversity.

On the other hand, the eastern islands (i.e. Sal, Boavista and Maio) are lower in elevation, they experience long periods of severe drought and they have poor vegetation content, with fewer endemics for which urgent conservation actions are also needed. However, implementation of the PAs was focused mainly on marine resources or fauna species, such as sea birds or turtles (Mauremootoo, 2012). Threats to the endemic plant species are driven mainly by habitat loss and anthropogenic disturbance, in particular related to tourist infrastructures and urban development. Especially on the coastal sands dunes of Sal and Boavista, tourism growth has caused dramatic habitat changes, already with noticeable negative impacts on the endemic flora: for instance, in the areas surrounding Praia de Santa Maria on Sal Island, where a small population of *Pulicaria burchardii* Hutch. subsp. *longifolia* Gamal-Eldin is undergoing fast decline.

Designating new PAs is a complex task, because there are competing land-use options and considerable socio-economic costs associated with PA implementation, thus suggesting that a species prioritization procedure should be mandatory. The assessment of conservation status provided in this study should be used by the Cape Verde government to provide guidance for future management and conservation efforts; this will help to ensure the survival of threatened species across the island network. Furthermore, the IUCN Red List assessments now provided for Cape Verde should become an important component of conservation prioritization in the Macaronesian Region, providing reliable data to update previous studies (e.g. Caujapé-Castells *et al*., 2010; Martín *et al*., 2010).

Conservation projects are time-sensitive and research funding opportunities in developing countries like Cape Verde are becoming increasingly restricted, but our ability to embrace informed, integrative approaches to biodiversity science is always contingent on the availability of scientifically sound data. This Red List provides a first comprehensive framework to identify and prioritize threatened species, thus constituting a crucial step towards a better strategy to conserve the endemic flora in the southernmost archipelago of Macaronesia.

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REFERENCES

Akçakaya HR, Ferson S, Burgman MA, Keith DA, Mace GM, Todd CR. 2000. Making consistent IUCN classifications under uncertainty. *Conservation Biology* **14:** 1001–1013.

Akçakaya HR, Root WT, Ferson S. 2001. *RAMAS*® Red List: threatened species classifications under uncertainty. Version 2.0. Applied Biomathematics, Setauket, New York.

Bachman S, Moat J, Hill AW, de la Torre J, Scott B. 2011. Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. *ZooKeys* **150:** 117–126.

Banãres A, Blanca G, Guemes J, Moreno-Saiz JC, Ortiz S, eds. 2004. *Atlas y Libro Rojo de la flora vascular amenazada de España, 2nd edn*. Madrid: Ministerio de Medio Ambiente, Dirección General de Conservación de la Naturaleza.

Bilz M, Kell SP, Maxted N, Lansdown RV. 2011. *European Red List of vascular plants*. Luxembourg: Publications Office of the European Union.

Bramwell D, Caujapé-Castells J. 2011. *The biology of island floras*. Cambridge: Cambridge University Press.

Brochmann C, Rustan ØH, Lobin W, Kilian N. 1997. The endemic vascular plants of the Cape Verde Islands, W Africa. *Sommerfeltia* **24:** 1–356.

Buerki S, Callmander MW, Bachman S, Moat J, Labat J-N, Forest F. 2015. Incorporating evolutionary history into conservation planning in biodiversity hotspots. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences* **370:** 20140014.

Caujapé-Castells J, Tye A, Crawford DJ, Santos-Guerra A, Sakai A, Beaver K, Lobin W, Florens FBV, Moura M, Jardim R, Gomes I, Kueffer C. 2010. Conservation of oceanic island floras: present and future global challenges. *Perspectives in Plant Ecology, Evolution and Systematics* **12:** 107–130.

Duarte MC, Gomes I, Moreira I. 2002. Ilha de Santiago (Cabo Verde) – Notas florísticas e fitogeográficas (II). *Garcia de Orta, Série de Botânica* **15:** 55–58.

Duarte MC, Rego F, Romeiras MM, Moreira I. 2008. Plant species richness in the Cape Verde Islands: ecogeographical determinants. *Biodiversity and Conservation* **17:** 453–466.

Duarte MC, Romeiras MM. 2009. Cape Verde islands. In: Gillespie R, Clague D, eds. *Encyclopedia of islands*. Berkeley: University of California Press, 143–148.

ESRI Environmental Systems Research Incorporated. 2011. *ArcGIS 10.0*. Redlands, CA: Environmental Systems Research Inc.

García-Verdugo C, Sajeva M, La Mantia T, Harrouni C, Msanda F, Caujapé-Castells J. 2015. Do island plant populations really have lower genetic variation than mainland populations? Effects of selection and distribution range on genetic diversity estimates. *Molecular Ecology* **4:** 726–741.

Gomes I, Gomes S, Kilian N, Leyens T, Lobin W, Vera-Cruz MT. 1995. Notes on the flora of the Cape Verde Islands, W Africa. *Willdenowia* **25:** 177–196.

Gonçalves AE. 1999. Uma nova espécie de *Withania* (Solanaceae) de Cabo Verde. *Garcia de Orta, Série de Botânica* **14:** 149–151.

IUCN Standards and Petitions Subcommittee. 2014. Guidelines for using the IUCN Red List categories and criteria. Version 11. Prepared by the Standards and Petitions Subcommittee. Available at: http://www.iucnredlist.org/documents/RedListGuidelines.pdf

Jaén-Molina R. 2014. Applicability of the 'DNA barcoding' concept to the endemic flora of the Canary Islands. D. Phil. Thesis, Universidad de la Laguna, Spain.

Jetz W, Freckleton RP. 2015. Towards a general framework for predicting threat status of data-deficient species from phylogenetic, spatial and environmental information. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences* **370:** 20140016.

Kilian N, Galbany-Casals M, Oberprieler C. 2010. *Helichrysum nicolai* (Compositae, Gnaphalieae), systematics of a new dwarf local endemic of the Cape Verde Islands W Africa. *Folia Geobotanica* **45:** 183–199.

Knapp S, Vorontsova M. 2013. From introduced American weed to Cape Verde islands endemic: the case of *Solanum rigidum* Lam. (Solanaceae, *Solanum* subgenus *Leptostemonum*). *PhytoKeys* **25:** 35–46.

Kueffer C, Daehler CC, Torres-Santana CW, Lavergne C, Meyer JY, Otto R, Silva L. 2010. A global comparison of plant invasions on oceanic islands. *Perspectives in Plant Ecology, Evolution and Systematics* **12:** 145–161.

Ladle RJ, Whittaker RJ (eds). 2011. *Conservation biogeography*. Oxford: Wiley-Blackwell.

Leyens T, Lobin W. 1996. Primeira Lista Vermelha de Cabo Verde. *Courier Forschungsinstitut Senckenberg* **193:** 1–140.

Lobin W. 1986. Katalog der von den Kapverdischen Inseln beschriebenen Taxa höherer Pflanzen (Pteridophyta & Phanerogamae). *Courier Forschungsinstitut Senckenberg* **81:** 93–164.

Mace GM. 2004. The role of taxonomy in species conservation. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences* **359:** 711–719.

Mace GM, Collar NJ, Gaston KJ, Hilton-Taylor C, Akçakaya HR, Leader-Williams N, Milner-Gulland EJ, Stuart SN. 2008. Quantification of extinction risk: IUCN's system for classifying threatened species. *Conservation Biology* **22:** 1424–1442.

Maes D, Isaac NJ, Harrower CA, Collen B, Strien AJ, Roy DB. 2015. The use of opportunistic data for IUCN Red List assessments. *Biological Journal of the Linnean Society* **115:** 690–706.

Marrero Á. 2008. *Teline stenopetala* (Webb & Berthel.) Webb & Berthel. subsp. *santoantaoi* subsp. nov. para Santo Antão Islas de Cabo Verde. *Botánica Macaronésica* **27:** 89–100.

Marrero Á, Almeida Pérez R. 2013. Las orquídeas en Cabo Verde y redescubrimiento de *Eulophia guineensis* Lindl. (Orchidaceae) en la Isla de Brava. *Botánica Macaronésica* **28:** 63–70.

Marrero Á, Almeida RS. 2012. A new subspecies, *Dracaena draco* (L.) L. subsp. *caboverdeana* Marrero Rodr. & R. Almeida (Dracaenaceae) from Cape Verde Islands. *International Journal of Geobotanical Research* **2:** 35–40.

Martín JL, Cardoso P, Arechavaleta M, Borges PAV, Faria BF, Abreu C, Aguiar AF, Carvalho JÁ, Costa AC, Cunha RT, Fernandes FM, Gabriel R, Jardim R, Lobo C, Martins AMF, Oliveira P, Rodrigues P, Silva L, Teixeira D, Amorim IR, Homem N, Martins B, Martins M, Mendonça E. 2010. Using taxonomically unbiased criteria to prioritize resource allocation for oceanic island species conservation. *Biodiversity and Conservation* **19:** 1659–1682.

Martins ES, Diniz MA, Paiva J, Gomes I, Gomes S, eds. 2002. *Flora de Cabo Verde*. Lisbon: Instituto de Investigação Científica Tropical and Praia: Instituto Nacional de Investigação e Desenvolvimento Agrário.

Mauremootoo JR. 2012. Invasive plant management strategy for terrestrial protected areas in: Fogo, Santo Antão and São Vicente. Report produced as part of the UNDP/GEF Project: Consolidation of Cape Verde's Protected Areas System. Praia, Cape Verde.

MAAP. 2004. *Livro Branco sobre o Estado do Ambiente em Cabo Verde*. Direcção Geral do Ambiente: Ministério do Ambiente, Agricultura e Pescas. (Available at: http://www.sia.cv).

Moreno-Saiz JC, coord. 2008. *Lista Roja 2008 de la flora vascular española*, *Dirección general de medio natural y política forestal*. Madrid: Ministerio de Medio Ambiente y Medio Rural y Marino y Sociedad Española de Biología de la Conservación de Plantas.

Moreno-Saiz JC, Lozano FD, Gómez MM, Baudet ÁB. 2015. Application of the Red List Index for conservation assessment of Spanish vascular plants. *Conservation Biology* **29:** 910–919.

Myers N, Mittermeier RA, Mittermeier CG, Fonseca GAB, Kent J. 2000. Biodiversity hotspots for conservation priorities. *Nature* **403:** 853–858.

Paiva J, Martins ES, Diniz MA, Moreira I, Gomes I, Gomes S, eds. 1995–1996. *Flora de Cabo Verde*. Lisbon: Instituto de Investigação Científica Tropical and Praia: Instituto Nacional de Investigação e Desenvolvimento Agrário.

Patiño J, Carine M, Mardulyn P, Devos N, Mateo RG, González-Mancebo JM, Shaw AJ, Vanderpoorten A. 2015. Approximate Bayesian computation reveals the crucial role of oceanic islands for the assembly of continental biodiversity. *Systematic Biology* **64:** 579–589.

Pimm SL, Jenkins CN, Abell R, Brooks TM, Gittleman JL, Joppa LN, Raven PH, Roberts CM, Sexton JO. 2014. The biodiversity of species and their rates of extinction, distribution, and protection. *Science* **344:** 1246752.

Rankou H, Culham A, Sghir Taleb M, Ouhammou A, Martin G, Jury SL. 2015. Conservation assessments and Red Listing of the endemic Moroccan flora (monocotyledons). *Botanical Journal of the Linnean Society* **177:** 504–575.

Rede de Áreas Protegidas de Cabo Verde. 2015. Ministério do Ambiente, Habitação e Ordenamento do território. Cabo Verde. Available at: http://www.areasprotegidas.gov.cv (accessed May 2015).

Romeiras MM, Catarino L, Torrão MM, Duarte MC. 2011b. Diversity and origin of medicinal exotic flora in Cape Verde islands. *Plant Ecology and Evolution* **142:** 214–225.

Romeiras MM, Catarino S, Filipe AF, Magalhães MF, Duarte MC, Beja P. 2015a. Species conservation assessments in oceanic islands: the consequences of precautionary versus evidentiary attitudes. *Conservation Letters*. doi: 10.1111/conl.12212

Romeiras MM, Duarte MC, Santos-Guerra A, Carine MA, Francisco-Ortega J. 2014. Botanical exploration of the Cape Verde Islands: from the pre-Linnaean records and collections to the late 18th Century accounts and expeditions. *Taxon* **63:** 625–640.

Romeiras MM, Monteiro F, Duarte MC, Schaefer H, Carine M. 2015b. Patterns of genetic diversity in three plant lineages endemic to the Cape Verde Islands. *AoB Plants* **7:** plv051.

Romeiras MM, Paulo OS, Duarte MC, Pina-Martins F, Cotrim MH, Carine MA, Pais MS. 2011a. Origin and diversification of genus *Echium* (Boraginaceae) in Cape Verde islands: a phylogenetic study based on ITS (rDNA) and cpDNA sequences. *Taxon* **60:** 1375–1385.

Sundseth K. 2009. *Natura 2000 in the Mediterranean region*. Luxembourg: Office for Official Publications of the European Communities.

Tittensor D, Walpole M, Hill SL, Boyce DG, Britten GL, Burgess ND, Visconti P. 2014. A mid-term analysis of progress toward international biodiversity targets. *Science* **346:** 241–244.

Vasconcelos R, Brito JC, Carranza S, Harris DJ. 2013. Review of the distribution and conservation status of the terrestrial reptiles of the Cape Verde Islands. *Oryx* **47:** 77–87.

Whittaker RJ, Araújo MB, Jepson P, Ladle RJ, Watson JEM, Willis KJ. 2005. Conservation biogeography: assessment and prospect. *Diversity and Distributions* **11:** 3–23.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Figure S1. Species geographical range [AOO (area of occupancy) and EOO (extent of occurrence)] for the 72 endemic species classified under threatened categories [Critically Endangered (CR), Endangered (EN), Vulnerable (VU)].

Figure S2. Status change of the Cape Verde endemic flora in the IUCN Red List from 1996 (Leyens & Lobin, previous inventory) to 2015 (present assessment). Species classified in 1996 as Undetermined (applied when it was not possible to accurately classify a species into any of the threatened categories CR, EN or VU) or Rare (species restricted to isolated populations and for which there was not enough information to determine their conservation status, but corresponding most likely to CR, EN or VU) were considered here as Threatened.