Short Communication

The conservation of the endemic vascular flora of Ascension Island and threats from alien species

Alan Gray, Tara Pelembe and Stedson Stroud

Abstract We present the first assessment of the endemic vascular flora of Ascension Island for over 20 years. Combining new with existing data the following IUCN Red List categorizations are proposed: *Anogramma ascensionis*, *Dryopteris ascensionis*, *Oldenlandia adscensionis* and *Sporobolus durus* (Extinct); *Pteris adscensionis* and *Euphorbia origanoides* (Critically Endangered); *Sporobolus caespitosus* (Vulnerable); *Asplenium ascensionis*, *Marattia purpurascens* and *Xiphopteris ascensionensis* (Near Threatened). The primary cause of the four presumed extinctions appears to be introductions of exotic species and subsequent alteration of ecological conditions. *M. purpurascens*, *A. ascensionis*, and *X. ascensionensis* appear to be under no immediate threat of extinction, although long-term survival is uncertain. *E. origanoides*, *P. adscensionis*, and *S. caespitosus* require active conservation measures to ensure their survival.

Keywords Ascension Island, exotic species, flora, Red List.

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Ascension Island (97 km^2) is a volcanic island in the South Atlantic Ocean (7°57′S, 14°22′W). Its closest neighbour is St Helena 1,127 km to the south. Approximately 1 million years old (Nielson & Sibbett, 1996), a distinctive flora has evolved on Ascension, in common with many other oceanic islands. The last Red List assessment of the vascular flora of Ascension (Cronk, 1980) concluded that of the 10 endemic species, 1 was Extinct, 5 Endangered and 4 Rare. The principal cause of the extinction and threats were 19th century introductions of exotic species (Cronk, 1980). As the island is still in a state of ecological flux, a reassessment of the Red List status of the flora is long overdue.

The climate of Ascension largely reflects its altitudinal gradient but is modified by the south-east trade winds (Duffey, 1964). On the coast at Georgetown temperatures are 27–31°C and mean annual rainfall *c*. 140 mm; temperatures at 660 m on Green Mountain are 6°C lower than at Georgetown and mean annual rainfall is *c*. 680 mm (Ashmole & Ashmole, 2000). Green Mountain is often shrouded in mist and a high proportion of the rainfall is in the form of occult deposition. The low-lying lava plains exhibit xeric conditions common to many desert habitats, and higher areas on the lava plains, such as Sisters Peak, remain dry for much of the time.

Studer (1889 cited in Duffey, 1962) distinguished three vegetation zones, elaborated by Duffey (1962). Although the details have changed since the visits of both Studer and Duffey, indicating Ascension's vegetation ecology to be in a state of flux, the zones remain useful for descriptive purposes.

Zone 1 Dry area below 330 m. Similar to Duffey's description, with patchy but often extensive vegetation, especially after rain, with species including the endemic *Euphorbia origanoides* L., the native *Aristida adscensionis* L. and *Cyperus appendiculatus* Kunth, and the introduced *Enneapogon cenchroides* (Licht.) C.E.Hubb., *Argemone mexicanca* L., *Heliotropium* sp., *Nicotiana glauca* R.Grah., and *Waltheria indica* L.. The most notable change is the addition of *Prosopis juliflora* (Sw.) DC., which dominates large areas and has displaced much of the *Acacia* scrub described by Duffey.

Zone 2 Between 330 and 660 m. A more complete coverage of vegetation with patchy mosaics of *P. juliflora*, *Juniperus bermudiana* L., *Causurina equisetifolia* L., *Tecoma stans* (L.) H.B. & K., *Opuntia* sp., *Leucaena leucocephala* (Lam.) de Wit, *Lantana camara* L., *N. glauca*, *Psidium guajava* L., and *Acacia* spp.. This is the zone where the grass *Melinis minutiflora* attains its highest abundance.

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Zone 3 Mist region from 660 to 850 m. This zone has been erroneously described as rainforest (Pearce, 2004). The vegetation forms an almost complete cover made up of a mosaic of grassland, scrub, woodland, bamboo (on the summit) and ginger. Species in this mosaic include *Alpinia zerumbet* (Pers.) B.L.Burtt & R.M.Smith, *Bambusa* sp., *J. bermudiana* I spp., *Sporobolus africanus* (Poir.) Robyns & Tournay, and *Paspalum* spp.

Further details of the physical characteristics of Ascension Island are provided by Duffey (1964) and Ashmole & Ashmole (2000), and fuller discussions of flora, ecology and conservation by Duffey (1964), Cronk (1980, 2000), Packer & Packer (1997), Ashmole & Ashmole (2000), Gray *et al.* (2000) and Gray (2003).

Here we examine the threats to the flora of Ascension (Gray, 2004; Wilkinson, 2004) and reassess the Red List status of the endemic species (Walter & Gillet, 1998) using the most recent criteria (IUCN, 2001). There is no plant checklist for Ascension and taxonomic nomenclature therefore follows Cronk (1980, 2000). The historically recorded sites of all the endemic vascular plants were surveyed in 1998, 2002 and 2003, and with a brief visit in November 2004 to assess *E. origanoides*. Survey work was broadened in 2002 and 2003, covering almost all of the island with the exception of inaccessible cliffs. This provided estimates of population size and island distribution, and recorded any threats, including evidence of habitat change and associated alien species. Introduced species that are capable of displacing an endemic by dominating a particular site and altering ecological conditions, such as light, nutrients and moisture availability, were categorized as severe threat species (Table 2). This was done with reference to a range of sources but all are included in the SEPASAL database (Royal Botanic Gardens, Kew 1999), Cronk & Fuller (2000) and Weber (2003).

The flora of Ascension comprises *c*. 25 native vascular plants of which 10 are endemic (Cronk, 1980) (Table 1), and *c*. 280 introduced species (Appendices 1–2). Many introduced species are present at locations that have endemics (Table 1), and most of these sites contain severe threat species (Table 2). Of the 13 severe threat species, *P. juliflora* represents a threat not only to native plants but also to turtle nesting beaches (Fowler, 1998; Pickup, 1999). Control of this species has been discussed elsewhere (Fowler, 1998) but the future of *E. origanoides* (especially for any restoration projects) may depend on the extermination of *P. juliflora* in specific areas and containment of the feral sheep and donkey populations that disperse seeds. Goats have also been implicated in the extinction of at least one endemic species, *Oldenlandia adscensionis* (DC.) Cronk, although goats are no longer present on the island (Cronk, 1980, 2000; Ashmole & Ashmole, 2000). If the extant endemic species on Ascension are to expand their range, some control will be required for all the severe threat species.

Little is currently known about the biology and ecology of the endemic species. Studies on the flora have been sporadic (Duffey 1964; Cronk, 1980; Gray *et al.*, 2000) and have concentrated on distribution rather than ecology or practical conservation. Although an ecological investigation of *E. origanoides* was commissioned in 2003 there are currently, to our knowledge, no plans to repeat this type of work for any of the other endemics. Details of the population dynamics of the endemics is limited to anecdotal information. The estimated total area covered by populations of endemic species in 2003 appears to be greater than that given by Cronk (1980), but although this may represent a real increase it could also reflect the greater recording effort of later surveys. It is difficult to assess population dynamics without consistent and standardized monitoring. All endemic populations are localized and fragmented and, in the case of *P. adscensionis*, there are few individuals remaining (Table 1).

The best information available for any population is for *E. origanoides*. The increase in area occupied by the species from 1958 (50 ha) to 1976 (75 ha) was in part because of the appearance of a new population at South Gannet Hill, now holding *c*. 90% of the island population. The decrease from 1976 to 1998 (20 ha) seems to have been a combination of the loss of the English Bay population because of construction work and the effects of drier weather conditions. The rise from 1998 to 2003 (24 ha) coincided with wetter climatic conditions (192 mm in 2003 compared to 97 mm in 1998). Population fluctuations seem to be characteristic of this species, partly accounted for by rainfall events (Gray, 2003). A previously unrecorded population of *c*. 1,000 individuals near Wig Hill was recorded in 2003. This is important because the population at South Gannet Hill suffered a 50% reduction (pers. obs., November 2004), perhaps because of expansion of the rabbit population following feral cat control; recent analysis of rabbit faeces found fragments of *E. origanoides* (pers. obs., November 2004).

The most significant change in Red List status is the categorization of *Sporobolus durus, Dryopteris ascensionis* and *Anogramma ascensionis* as Extinct (Table 1). The only places where they could still exist would be in a remote ravine or on a cliff face. Reported sightings of *D. ascensionis* (1975) and *O. adscensionis* (in the 1980s) remain unconfirmed (Cronk, 1980, 2000). The categories of *Asplenium ascensionis*, *Marattia purpurascens* and *Xiphopteris ascensionensis* are unchanged as their populations appear to be large enough for survival, at least in the short-term. *Sporobolus caespitosus* has been categorized to a higher threat category than these three species because of the threat of encroachment of surrounding exotic vegetation.

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Table 1 Species endemic to Ascension Island, with their original Red List status (Cronk, 1980), updated Red List status and criteria (see IUCN (2001) for an explanation of the criteria), justification for the reassessment, estimated population size, number of localities in which found and number of these where severe threat species (Table 2) are present, total area covered by each species, and total number of associated native species and associated exotic species recorded from all localities where endemics were found.

Species (Family)	1998 Red List status[1]	2004 Red List status (criteria)[1]	Justification	Est. pop. size	No. localities (no. with severe threat species)	Total area (km^2)	No. associated native species	No. associated exotic species
Euphorbia origanoides L. (Euphorbiaceae)	Rare	CR (B1 + B3c)	Population may be unstable; apparent decline over last 50 years but population behaviour appears ephemeral; *P. juliflora* a severe threat; population highly localized, 93% in one area, vulnerable to catastrophic events.	*c.* 23,000	18 (10)	< 1	1	10
Sporobolus caespitosus Kunth (Poaceae)	EN	VU (D2)	Highly localized small population; probable decline over last 150 years inferred from information in Hooker (1867), Duffey (1964) & Cronk (1980); vulnerable to catastrophic events	*c.* 1,000	9 (5)	< 1	2	17
Sporobolus durus Brogn. (Poaceae)	EN	EX	Last seen 1886 (Cronk, 1980)					
Oldenlandia adscensionis (DC.) Cronk (Rubiaceae)	EX	EX	Last seen 1889 (Cronk, 1980)					
Asplenium ascensionis S. Watson (Aspleniaceae)	Rare	NT	Localized but large population; no immediate threats but may be prone to long-term threats such as encroachment by *Adiantum cappileus-veneris*.	> 5,000	16 (7)	< 1	2	22
Anogramma ascensionis (W.J. Hooker) Diels (Adiantaceae)	EX	EX	Last seen 1958 (Duffey, 1964)					
Pteris adscensionis Swartz (Adiantaceae)	EN	CR (B1)	Highly localized small population; severe decline over last 150 years inferred from information in Hooker (1867), Duffey (1964) & Cronk (1980); future bleak without population restoration programme.	150–200	7 (5)	< 1	2	13
Dryopteris ascensionis (Hook) O. Kuntze (Dryopteridaceae)	EN	EX	Last seen 1889 (Cronk, 1980)					
Xiphopteris ascensionensis (Hieronymus) Cronk (Grammitidaceae)	Rare	NT	Localized but large population; no immediate threats but may be prone to long-term threats such as habitat change and/or encroachment by introduced species, e.g. *Alpinia zerumbet*.	> 5,000	9 (4)	< 1	3	13
Marattia purpurascens De Vriese (Marattiaceae)	Rare	NT	Localized population but no immediate threats; may be prone to long-term threats such as habitat change and/or encroachment by introduced species.	> 500	2 (1)	< 1	1	12

[1]EX, Extinct in the wild; CR, Critically Endangered; EN, Endangered; VU, Vulnerable; NT, Near Threatened

Table 2 Severe threat species (see text for details) and whether they are present (P) at locations where the six extant endemic species (Table 1) occur.

Species	*A. ascensionis*	*M. purpurascens*	*E. origanoides*	*P. adscensionis*	*S. caespitosus*	*X. ascensionensis*
Alpinia zerumbet (Pers.) B.L.Burtt & R.M.Smith		P				
Heliotropium sp.			P			
Juniperus bermudiana L.	P				P	
Lantana camara L.		P				
Leucaena leucocephala (Lam.) de Wit			P			
Melinis minutiflora Beauv.	P		P			
Nicotiana glauca R.Grah.			P	P		
Opuntia sp.	P			P		
Paspalum conjugatum Berg.	P				P	P
Paspalum scrobiculatum L.	P	P			P	
Prosopis juliflora (Sw.) DC			P			
Psidium guajava L.	P		P	P	P	P
Sporobolus africanus (Poir.) Robyns & Tournay	P				P	P

This plant inhabits near vertical cliff faces and populations are therefore potentially susceptible to catastrophic events. We have categorized *E. origanoides* as Critically Endangered because of the presence of *P. juliflora* and a highly localized distribution and fluctuating population size, which increase susceptibility to catastrophic events.

Because of the low species diversity of Ascension, Cronk (1980) suggested that the endemic plant species are poor competitors. Although this assumption has not been explicitly tested, the ecological changes on Ascension Island in recent times support this contention (Ashmole & Ashmole, 2000) and both introduced plants and feral animals remain the most pervasive threats. There has been an increase from 25 native species to 200–300 vascular plant species in *c*. 100 years (Ashmole & Ashmole, 2000) and this has had disastrous consequences for the native plants (Duffey, 1964; Cronk, 1980, 2000; Ashmole & Ashmole, 2000). Although mass introductions have ceased, plants are still colonizing the island. Recent additions include *P. juliflora*, an extremely successful colonizer of the lava plains, and a species of *Heliotropium* that has rapidly colonized many coastal areas since its introduction in the 1990s. The 1958 map (Duffey, 1964) of the vegetation is now out of date for many areas, particularly with regard to *P. juliflora*. Without control measures the likelihood of more problem species arriving remains high. Funding is being sought for a regional invasive species control programme that will build the infrastructure necessary to control the imports of invasive plant species.

The future of the endemic vascular flora of Ascension remains uncertain. Cronk (2000) stated that, unlike St Helena, there is little that can be done for plant conservation on Ascension as endemics have either successfully adapted or gone extinct. However, the continuing and increasing presence of introduced species continue to pose new threats. The cultivation of *Pteris adscensionis* advocated by Cronk (2000) could be extended to all endemic species. The newly created Governmental Organiation, Ascension Island Conservation, has recently gained funding to develop Green Mountain as a National Park, a key component of which is the creation of a nursery, the propagation of endemic plants and trial reintroductions.

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Appendices 1–2

The appendices for this article are available online at http://journals.cambridge.org

Biographical sketches

Alan Gray is currently researching management of vegetation and carbon fluxes in peatland ecosystems in the UK. He has conducted research on the endemic vascular flora of Ascension Island since 1998.

Tara Pelembe carries out research on the conservation of Ascension's biodiversity, including seabirds, marine turtles and vegetation.

Stedson Stroud's research interests are in the practical conservation of the endemic flora of Ascension Island, including techniques for the restoration of endemic plant populations.