

Status of plant conservation in oceanic islands of the Western Indian Ocean

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Abstract

We review plant conservation in the Mascarenes (Réunion, Mauritius, Rodrigues) and the granitic Seychelles islands. Sizes of angiosperm floras are: Seychelles (200 species, c. 70 endemics of which c. 70% are threatened), Mauritius (691 species of which 273 are single island endemics [SIE] and another 150 are Mascarene endemics [ME]), Rodrigues (150 species, 47 SIE, 72 ME), Réunion (550 species, c. 165 SIE, c. 140 ME). The main threats affecting plant diversity are small population sizes and fragmentation, and invasive alien species. While in Mauritius, Rodrigues and Seychelles <5% of intact habitat is left, this proportion is still 30% in Réunion. Consequently habitat restoration is a priority in Mauritius, Rodrigues and Seychelles. All islands have recently greatly advanced some aspects of plant conservation, while gaps are also apparent. Advances include conservation strategies (all), *ex situ* conservation (all), extent of protected areas (Réunion, Seychelles), new NGOs (Réunion, Seychelles) and outreach (Réunion, Seychelles). Weaknesses include lack of government support (Mauritius, Rodrigues), local scientific expertise (Mauritius, Rodrigues, Seychelles). Given the similarity in biogeography and past and current anthropogenic disturbances a regional plant conservation network and strategy needs to be strengthened.

Keywords

Angiosperm flora; conservation status; granitic Seychelles; Mascarenes; Mauritius; oceanic island; Réunion; Rodrigues

Introduction and aims

The importance of islands for the conservation of global plant diversity is disproportionately high relative to the small land surface area they occupy (Kreft *et al.*, 2008). However, humans have already heavily affected island ecosystems (Millennium Ecosystem Assessment [MEA], 2005; Whittaker and Fernández-Palacios, 2007; Kingsford *et al.*, 2009) and, in the foreseeable future, human pressure on ecosystems will likely increase more markedly on islands than on continents (Brooks *et al.*, 2002; MEA 2005; Kier *et al.*, 2009). In consequence, island plant conservationists are faced with a huge conservation challenge and though they could learn much from each other, contact among researchers and managers of threatened plants on different archipelagos worldwide has been generally limited (Caujapé-Castells *et al.*, 2010). If we are to maximise potential benefits from inter-island exchanges between researcher and managers, an important prerequisite is to conduct an accurate and up to date review of the status of plant conservation on these islands. The aim of this paper is thus to provide a summary of the current taxonomical knowledge of the angiosperm floras of the Mascarenes (Mauritius, Réunion and Rodrigues) and the granitic islands of Seychelles, evaluate their conservation status and finally unravel the major conservation achievements and gaps.

Study islands and methods

The major physical characteristics of the islands of the Mascarenes and granitic Seychelles as they pertain to plant diversity and conservation along with their respective native angiosperm flora are summarized in Table 1. A relatively low diversity but high endemism is apparent as is indeed typically the case for isolated and high oceanic islands.

The Mascarenes and granitic Seychelles share a broadly similar human colonisation history which over the years came to strongly influence the islands' native habitats. All three Mascarene Islands started being settled in the 17th century, while the granitic Seychelles was colonised a little later around the mid 18th century. The Seychelles and the Republic of Mauritius (which includes Rodrigues) got their independence from British colonial administration about 40 years ago while Réunion has remained a French territory.

Overall the angiosperm flora of the region is generally well known. This is partly related to a long tradition of botanical studies particularly for the flora of Mauritius and Réunion which started to be systematically surveyed in the late 18th century with Commerson (1768). Botanical surveys of the flora of the granitic Seychelles started in earnest somewhat later in 1840 (Friedman, 1994) while that of Rodrigues was the last, in 1874, to draw the attention of botanists (Balfour, 1879), when unfortunately much of the native vegetation was already destroyed (Horne 1875; Balfour 1879) and a number of species doubtless had already gone extinct before being formally described as can be deduced from Leguat (1708).

Among the islands, Mauritius had its Flora published first (Bojer, 1837), followed by the Seychelles (Baker, 1877), Rodrigues (Balfour, 1879) and Réunion (Cordemoy, 1895). The flora of the Mascarenes is being thoroughly updated through the 'Flore des Mascareignes' project which started in the early 1970's and is about to be completed with only three families remaining to be published. The most updated Flora for the Seychelles is that of Friedmann (1994), who however flags a number of unresolved taxonomic problems with some groups, such as the Rubiaceae, Euphorbiaceae and Phyllanthaceae. Friedmann (1994) covers only dicotyledons, while for monocotyledons only a checklist exists (Robertson, 1989).

Despite the small sizes of the islands and their long history of botanical inventories (ranging between 135 and 240 years) new endemic species are still being discovered (e.g. Florens & Baider, 2006; Le Péchon, 2009) as are non-endemic natives (e.g. Roberts *et al.*, 2004). Traditional morphological studies are also still leading to the splitting of single into several species (e.g. Bosser 2005), while other studies are sinking previously recognised species (e.g. *Gaertnera* in Mauritius, Malcomber & Taylor, 2009). A molecular approach to delimit species/genera is also being used (e.g. Le Péchon, 2009; Plunkett & Lowry, in press). All these works are leading to a constantly evolving knowledge and size of the flora of all the islands.

In this paper we review the native angiosperm flora sizes, endemism and their degree of threat, as well as the status of plant conservation in the Mascarene Islands and the granitic Seychelles. We based our review on the latest available documents and on contributions of experts from each island or island group.

Results and discussion

Diversity and endemism

The total native angiosperm flora of each island vary between 150 to 691 species, summing up to 555 single island endemic species (if the granitic Seychelles is counted as a single island), with an island endemism varying between 30-39.5% (Table 1). The Seychelles has an angiosperm flora estimated at 200 species, with c. 70 endemics. In the Mascarenes,

Rodrigues has the smallest flora with 150 species, followed by Réunion (550) and Mauritius (691). For the Mascarenes, some of these species occur in 2 or all three islands of the archipelago. Such Mascarene endemics (ME) are distributed as follows: Rodrigues, 72; Réunion, 140; Mauritius, 150. An important percentage of the Mascarenes plants are single island endemics (SIE): Rodrigues, 47; Réunion, 165; Mauritius, 273 (Table 1).

Red List categories and threats

For all islands, the percentage of threatened species *sensu* IUCN (2001) is relatively well known though many species do not yet appear in the official IUCN Red List. In the granitic Seychelles, it is estimated that 2-5 (2-6%) species are extinct, with 70% of the endemic species considered threatened with extinction. For the Mascarenes, considering SIE only for example, Rodrigues has the highest rate of extinction (10 species or 21.3%), followed by Mauritius (30 species, 10.9%) and Réunion (2 species, 1.2%). The level of threatened SIE is high in all islands (Mauritius, 81.7%; Rodrigues, 77.8%; Réunion, 50.9%). These high levels of threatened species are largely the consequence of high rates of past habitat destruction for agriculture and other land uses. While less than 5% of the original habitat is left in each of the granitic Seychelles, Mauritius and Rodrigues, in Réunion which has the lowest rates of extinction and threatened species, native cover is still relatively high (30%) although some community types like the dry forest have all but disappeared (Strasberg *et al.*, 2005). Past habitat destruction has generated two main and related threats currently affecting plant diversity in all the granitic Seychelles and the Mascarenes: small population sizes and fragmentation. However, the most important threat (on all islands) is posed by a variety of interactions with invasive alien species (both animals and plants). Socio-economic threats (e.g. demographic growth, tourism, etc.) are considered less severe than biological threats (Caujapé-Castells *et al.*, 2010).

Conservation achievements and gaps

All islands have recently greatly advanced some aspects of plant conservation, while certain gaps are however also apparent. Major advances include the production of conservation strategies for all the islands concerned (e.g. Beaver and Kueffer, 2005; Kueffer *et al.*, 2007), although implementation of these strategies is sometimes weak like in Mauritius. Similarly *ex situ* conservation is undertaken in all the islands. The extent of area protected for biodiversity conservation remains small in Mauritius and Rodrigues but has recently slightly increased in Mauritius with the setting up of the National Park of islets in 2004. A greater improvement occurred recently in extent of protected areas for the granitic Seychelles, and particularly for Réunion with the creation of a large National Park (> 1,000 km²). Creation of new conservation NGOs and improved outreach (e.g. the Seychelles plant conservation newsletter 'Kapisen', see <http://www.plantecology.ethz.ch/publications/books/kapisen>) have also been noted recently in the Seychelles and Réunion, while Mauritius and Rodrigues both already have strong and active NGOs.

Conservation of island biodiversity often necessitates active ecological restoration where invasive species are, if not eradicated, at least controlled (Simberloff, 2001). This situation applies well to the islands studied here where some well known success stories in saving animal species already exist, for example on Mauritius (Jones, 2008). Ecosystem restoration has however been generally slow to follow particularly on Réunion where prohibitive costs appear to be a sizeable obstacle. However, some degree of ecosystem restoration is being undertaken on all islands (e.g. Florens, 2008; Samways *et al.*, 2010). Such work is particularly advanced on Mauritius for example with the so-called 'Conservation Management Areas' (comprising of forest patches weeded of alien plants and fenced against large hoofed alien mammals) which however remains to be extended beyond the currently tiny areas concerned.

Other gaps, applying particularly to the Seychelles, Mauritius and Rodrigues include a lack of human and financial resources in conservation research and management. The islands' local governments seem to recognise the importance of conservation, but do not follow up with meaningful support. In Réunion, such problems are less acute because the island typically benefits from a large pool of expertise from France. Establishment of regional networks to exchange expertise and experience could help decrease such weakness and improve plant conservation. Given the similarity in biogeography and past and current anthropogenic disturbances, it would be ideal to set up a strong regional plant conservation network (including Comoros and Madagascar) as well as envisage creating regional strategies on conservation and research.

Conclusions

The granitic Seychelles and the Mascarene Islands hold a globally important angiosperm flora with high level of endemism which however is currently highly threatened due mainly to extensive past habitat destruction and current impacts of invasive alien species. The tasks of conservationists are made more difficult by a general lack of human and financial resources as well as governmental commitment particularly in the case of the Seychelles and the Republic of Mauritius (includes Rodrigues), although some encouraging important development has been achieved recently. The management capacity on these islands is thus vulnerable and the long-term institutional and financial support of the few key persons per island is rarely secured. Finally, it appears that there is scope for networking and strengthening plant conservation on islands given the similarity of challenges and solutions facing them regarding the conservation of their plant diversity.

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Table 1: The islands studied, their geological origin, age, land area, maximum altitude, isolation from nearest landmass and the size of their native angiosperm flora including the respective proportion of single island endemic species.

Islands	Geological origin	Age (MA)	Size (Km ²)	Maximum altitude (m)	Nearest main landmass (km)	Number of species	Number (%) endemics
Seychelles*	Granitic (Continental)	>65	235	905	900	200 ¹	70 (35.0)
Reunion	Volcanic	3	2512	3070	665	550 ²	165 (30.0)
Mauritius	Volcanic	8	1865	828	900	691 ³	273 (39.5)
Rodrigues	Volcanic	10	109	398	1400	150 ⁴	47 (31.1)

* Seychelles comprises in this analysis mainly islands of continental origin. The archipelago has also coralline islands that are much younger (0.125-0.01 MA), small and with low diversity. Age is given for the time since complete separation from other landmasses.

1 = Friedmann, 1994; 2 = CBNM, 2010.; 3 = Baider & Florens, unpubl.; 4 = Baider, unpubl.