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VARIATION IN THE DISTRIBUTION OF SUPRALITTORAL VEGETATION AROUND AN ATOLL CAY: DESROCHES (AMIRANTE ISLANDS, SEYCHELLES)

BY

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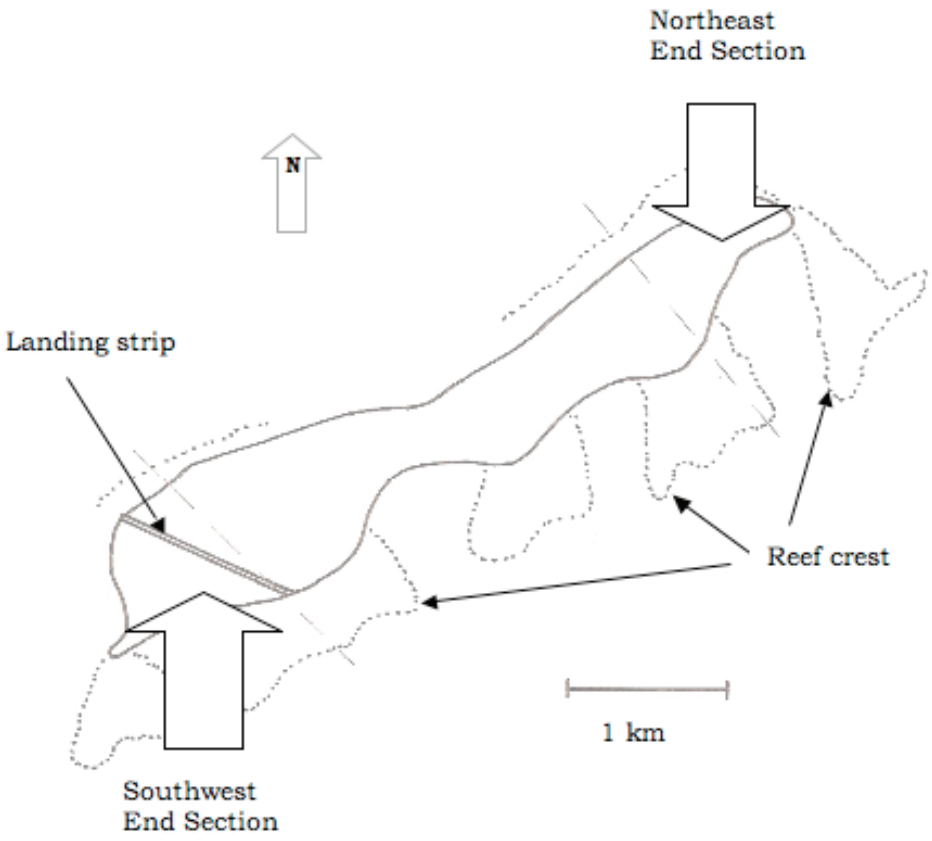

Figure 1. Coastline of Desroches cay, Amirante Islands, showing the location of the two 'end sections' (see text) and the landing strip.

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ABSTRACT

The shores of the small coral cay on Desroches Atoll (Amirante Islands, Seychelles) span a range of conditions from relatively sheltered (along the atoll lagoonal coast) to very exposed (facing the Indian Ocean). This appears in no way to affect the occurrence of Scaevola, which dominates the entire coastline, but the frequencies of the other characteristic but less widespread shoreline plant species (*Casuarina*, *Cocos*, *Guettarda*, *Suriana* and *Heliotropium*) show significant variation around the cay perimeter.

INTRODUCTION

In the popular imagination, especially of people living outside the tropics, coral islands are fringed by coconut palms. In reality, except on eroding shores, the dominant species is much more likely to be the somewhat less romantic *Scaevola*, variously known as 'salt bush', 'fan flower', 'Cardwell cabbage', 'naupaka', 'half-flower' and in Seychelles 'vouloutye', that pan-tropically forms – or used to form - dense impenetrable thickets at and above high tide level around atoll cays as well as around various other types of island. Although *Scaevola* is often the dominant component, several other plants may occur with it, including of course the coconut, *Cocos*.

Desroches is a low linear coral-sand cay, some 5km long, 0.5-1.0km wide and 2m high, oriented south-west to north-east on the southern margin of the large (20km diameter) sunken and tilted coral atoll of the same name in the Amirantes Group, Seychelles, at 5^0 40-42' S; 53^0, 38-41' E (see, e.g., Baker, 1963; Stoddart & Poore, 1970). Although most of its terrestrial vegetation is no longer in its natural state, and little evidence of its original biota remains (Stoddart & Poore, 1970) having been converted like many other Indian Ocean islands to a coconut plantation, except in the vicinity of

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the island's hotel the coastal fringe does appear to be in a largely natural state (although with some probably alien components). In this it contrasts with the coastal vegetation of many of the granitic Seychelles that has been severely changed by human activity (Sauer, 1967). This study set out to document the composition of the supralittoral vegetation around Desroches as an example of an atoll cay in the Indian Ocean and to ascertain whether this vegetation was uniform or contained significant local regional variation. The *Coral and Coastal Ecology of the Seychelles Research Programme* is one of the three component sections of the Mitsubishi Corporation's *Global Coral Reef Conservation Project*.

METHODS

In July 2006 the vegetation present at the top of the beach around the entire 11 km perimeter of Desroches, excluding only three small areas heavily modified by man - the north-coast frontage of the hotel and the two cleared ends of the associated landing strip - was surveyed at 30m intervals by walking right around the shore. Two features were noted at each station: the identity of the plant species occurring nearest to the sea, and that of the plant species occurring immediately behind it (which could of course be of the same species).

Of the total of 368 stations worked, 175 were along the north coast of the island that faces the atoll lagoon, and 193 were along the exposed, oceanic, south coast which forms a series of bays (87 stations) and headlands (106 stations) (see Fig. 1). For the purposes of comparison, each coast was somewhat arbitrarily divided into the two 1.2 km long end sections, and the longer central regions (2.8 km on the lagoonal shore and 3.3 km on the oceanic).

Analysis of distribution patterns was carried out using X^2 tests, where a species' 'expected' local presence was set by its larger-scale frequency of occurrence; i.e. if a given species was found to occur at n% of stations around the island as a whole (or along a given shore, etc.) then the null hypothesis was that it should also be expected to occur at the same proportion of the stations present along any specific shore (or stretch of that shore).

RESULTS

Six stations (1.6%) possessed no living vegetation and a further 13 (3.5%) lacked an immediate seawards fringe, either because of natural habitat loss (indicated by the occurrence of a small erosion cliff and exposed roots) or because the *in situ* vegetation was apparently dead.

A total of only nine species were recorded, which in decreasing order of frequency were:

Scaevola taccada (Gaertn.) Roxb (at 86.5 % of stations)
Cocos nucifera L. (at 23.5 % of stations)

Heliotropium foertherianum Diane & Hilger (at 16.0 % of stations)
Suriana maritima L. (at 12.9 % of stations)
Guettarda speciosa L. (at 9.7 % of stations)
Casuarina equisetifolia L. (at 3.0 % of stations)
Hibiscus tiliaceus L. (at 1.9 % of stations)
Hernandia nymphaeifolia (Presl) Kubitzki (at 0.8 % of stations)
Ipomoea pes-caprae (L.) R.Br. (at 0.3 % of stations).

The supralittoral flora was therefore clearly dominated by bushy shrubs in that three of the four most frequent species (the Indo-Pacific *Scaevola taccada* and *Heliotropium foertherianum* (commonly known as *Tournefortia*, or *Argusia*, *argentea*)**,** and the pan-tropical *Suriana maritima*) were relatively low and multi-stemmed in growth habit. No strand-line grasses or herbs other than *Ipomoea* were present at the time of survey, only the shrub and tree ring. All four of the species present at more than 10% of stations are sea-water dispersed plants.

Scaevola dominated all shores of the island and there were no differences in its frequency between north and south coasts ($X^2 < 0.52$, $P > 0.4$), within each of the north and south coasts ($X^2 < 0.13$, $P > 0.5$; $X^2 < 0.03$, $P > 0.5$), or between the two ends of the island ($X^2 < 0.09$, $P > 0.5$). Indeed it effectively forms a continuous band around the perimeter of the island, as it does naturally at several other Indo-Pacific cays (Wiens, 1962; Stoddart & Fosberg, 1991; Goldstein *et al.*, 1996) and, un-naturally, outside the region where it is sometimes behaves as an invasive species, e.g. in Florida, USA (http://plants.ifas.ufl.edu.scaser.html) and in the British Virgin Isles (http://www.seaturtle.org/mtrg/projects/anegada/).

The *Scaevola* thickets contained abundant burrows of the, on Desroches, semi-terrestrial decapod crustacean *Ocypode cordimana* Desmarest and also sheltered several other decapods including *Coenobita perlatus* H.M.Edw., *C. rugosus* H.M.Edw. (the two latter often in the shells of the introduced gastropod *Achatina*) and *Geograpsus crinipes* (Dana).

Cocos ($X^2 > 33$, $P < 0.0001$), *Guettarda* ($X^2 > 17$, $P < 0.0005$) and *Casuarina* ($X^2 > 4.7$, $P < 0.05$), however, were more frequent on the north coast and less frequent on the south coast than expected, whilst *Suriana* showed the reverse distribution ($X^2 > 15$, $P < 0.0005$). *Heliotropium* displayed no differential frequency ($X^2 = 0$, $P > 0.9$) between the two coasts.

Within the north coastal strip, *Cocos* was more frequent than expected in the central region ($X^2 = 8.3$, $P < 0.005$) and less so at the north-eastern end ($X^2 = 5.8$, $P < 0.05$); *Heliotropium* and *Casuarina* were less frequent in the centre than at the north-eastern end ($X^2 > 14$, $P < 0.0005$; $X^2 > 4.9$, $P < 0.05$ respectively) and *Suriana* was more frequent than expected at the north-eastern end ($X^2 = 4.6$, $P < 0.05$); whilst all species occurred with the expected frequency at the south-western end ($X^2 < 3.5$, $P > 0.5$). The distribution of *Guettarda* showed no regional differentiation along the north shore.

Within the more impoverished south coast, the only departures from the expected frequencies were the more frequent *Heliotropium* ($X^2 = 5.8$, $P < 0.05$) and less frequent *Suriana* ($X^2 = 6.6$, $P < 0.01$) at the north-eastern end; *Suriana* thus reversing its pattern of occurrence along the north-coast in this respect. No differences were seen in the

frequencies of species around the south coast headlands as opposed to within the bays ($X^2 < 3.5$, $P > 0.1$).

In comparison of distributions at the south-western and north-eastern ends of Desroches, only *Heliotropium* showed a significant departure from the expected values in being less frequent in the south-west ($X^2 = 7.8$, $P < 0.01$) and more frequent in the north-east ($X^2 = 6.6$, $P < 0.025$).

Finally, comparison of the central regions of the northern and southern coasts showed that *Cocos* and *Guettarda* were more frequent along the central north than along the central south coasts ($X^2 > 33$, $P < 0.0001$; $X^2 > 15$, $P < 0.0005$ respectively), whilst *Heliotropium* and *Suriana* showed the reverse pattern ($X^2 > 5.3$, $P < 0.025$; $X^2 > 10.5$, $P < 0.005$ respectively).

DISCUSSION

Of the plants occurring around the coast of Desroches, one of the major arborescent species (*Cocos* - occurring at 23.5% of the stations) and three of the minor species (*Casuarina*, *Hibiscus* and *Hernandia* - occuring at 3% of the stations or less) are usually considered to have been introduced to the island (see, e.g., Stoddart & Fosberg, 1984). *Cocos* and *Casuarina* were introduced in the 19th Century, after virtual clearance of the island's natural terrestrial vegetation except for the coastal ring (Gardiner & Cooper, 1907; Piggott, 1961), the yield from coconut palms being greater when they are planted next to a large *Casuarina* (Piggott, 1961). Over the eastern half of Desroches, however, the coconut plantation has since been abandoned and allowed to revert to a wild state (known locally as 'Cocos Bon Dieu'), as frequently has occurred through the inner and granitic Seychelles (Hill, 2002). Specimens of *Hibiscus*, *Hernandia* (and several other tree species) were deliberately imported and planted around the hotel and central settlement. All four species, however, may have been part of the original vegetation and certainly naturally establish themselves today. Although *Hibiscus* and *Hernandia* are really only members of the supralittoral community adjacent to areas in which they have been planted, *Cocos* and *Casuarina* seem thoroughly to have naturalized themselves in the coastal habitat. Indeed many of the supralittoral *Cocos* recorded here are young plants clearly established from water-borne nuts deposited on the strand line.

The species recorded by this survey are similar to the ones listed earlier by Stoddart & Poore (1970), although we recorded no coastal-fringe *Ochrosia oppositifolia* (Lam.) K. Schum., *Pipturus argenteus* (G. Forst.) Wedd. or *Cordia subcordata* Lam. which those authors noted on the northern shore, whilst neither Stoddart & Poore (1970), Fosberg & Renvoize (1970) nor Robertson (1989) recorded the presence of *Hibiscus* on Desroches. As might be expected, the Desroches flora is also basically similar to that characterising undisturbed coastal areas on the nearby granitic Seychelles (Taylor, 1968; Proctor, 1984), and on other western Indian Ocean cays (Stoddart & Fosberg, 1984). Indeed the same elements (genera if not species) occur right across the Indian and Pacific Oceans, if not more widely.

The two coasts of the island show several differences. The exposed, ocean-facing south coast possesses an extensive reef platform that receives heavy wave action and is uncovered or almost uncovered by low spring tide; at the landwards margin of the reef platform are often long stretches of beach rock; and the sand at the top of the beach is relatively coarse and the slope down to the beach rock relatively steep. The lagoon-facing north coast, however, has no beach rock or reef platform and possesses a small, steep, fine-sand intertidal zone that descends rapidly into the relatively deep sheltered lagoon. The two ends of the island also contrast; the south-western end being formed by a beach-rock 'spit' (and bears on its northern shore the hotel) whilst the north-eastern tip comprises an accumulation of coral rubble. Although the dominant *Scaevola* appears completely unaffected by this regional variation being equally frequent in all sectors, the distributions of the other plant species are consonant with these differing circumstances. The trees *Cocos*, *Guettarda* and *Casuarina* (especially *Cocos*) occurred principally along stretches of relative shelter, as did the *Ochrosia oppositifolia*, *Pipturus argenteus* and *Cordia subcordata* reported by Stoddart & Poore (1970), whilst the shrubs *Suriana*, and to a lesser degree *Heliotropium*, were more frequently found where more exposed conditions prevailed. The differential effect of exposure on trees and shrubs is what one would expect, but it will be interesting to see if its apparent effect on *Suriana* and *Heliotropium*, and lack of effect on the frequency of *Scaevola* are also found elsewhere. On cays of the Great Barrier Reef, Australia, *Heliotropium foertherianum*, and occasionally *Casuarina*, may form complete rings around an island, *Heliotropium* occurring in a monospecific stand (although *Scaevola* species also occur on other islands and may indeed dominate the vegetation, as here) (Heatwole, 1984).

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