ATOLL RESEARCH BULLETIN

NO. 576

TERRESTRIAL AND MARINE ECOLOGY OF DESNOEUFS, AMIRANTES, SEYCHELLES

BY

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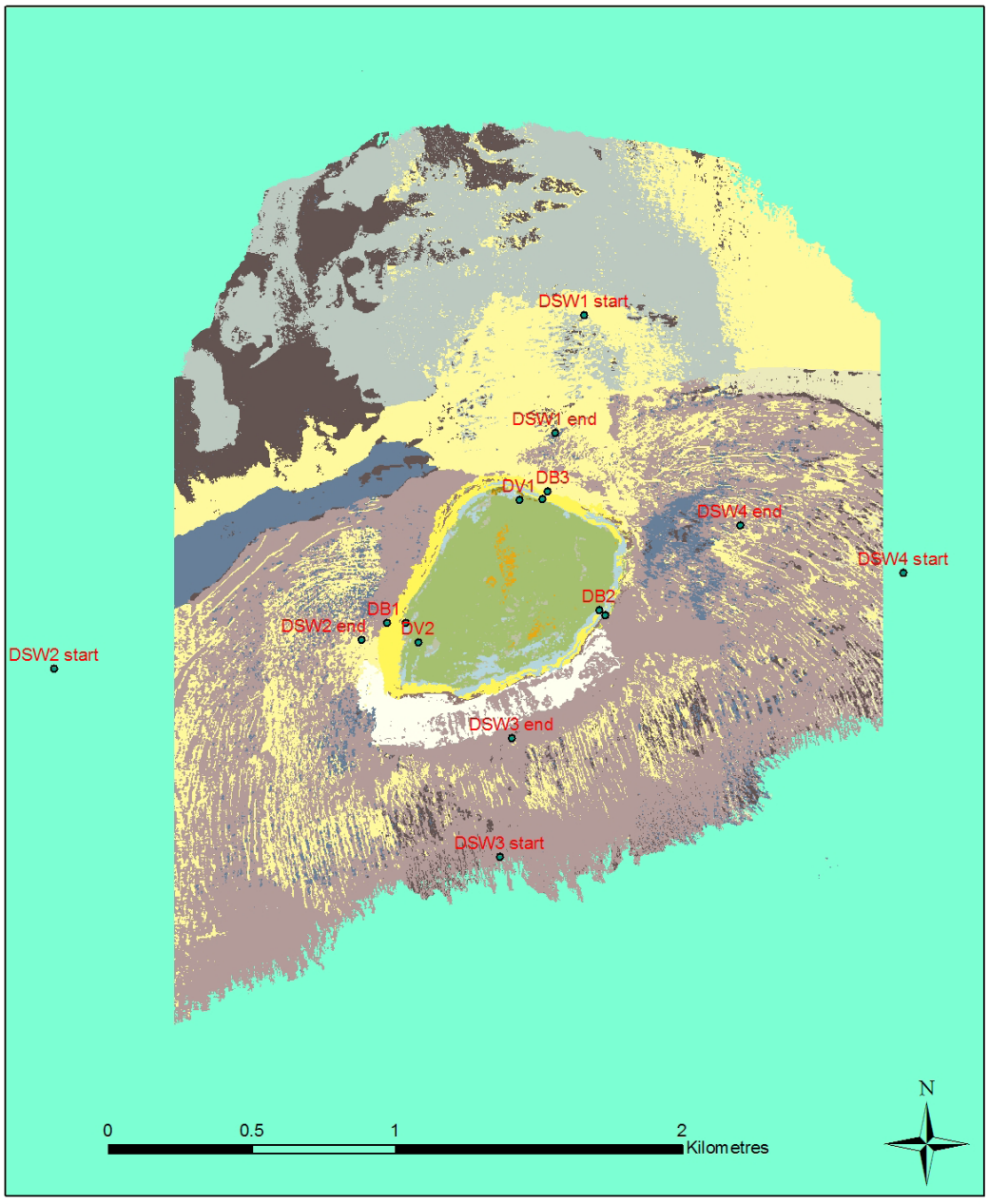
SMITHSONIAN INSTITUTION
WASHINGTON, D.C., U.S.A.
MARCH 2010



Habitat classes

Unclassified	Mangrove woodland	Fore-reef slope sand	Cleared / bare ground
Saline pond	Low density seagrass / macroalgae	Fore-reef slope rubble and sand	Buildings and other structures
Rocky fore-reef slope	Littoral hedge	Fore-reef slope coral spurs with coralline algae	Beachrock
Rock pavement	Lagoon sand	Coral sandstone / raised reef	Beach sand
Reef-flat sand	Lagoon patch reef	Coral rubble with coralline algae	
Other trees and shrubs	High density seagrass	Coral boulders	
Medium density seagrass	Herbs and grasses	Coconut woodland	

Figure 1. Location of vegetation Line Intercept Transects (DV1 and DV2), beach profiles (DB1, DB2 and DB3) and shallow-water transects (DSW1, DSW2, DSW3 and DSW4) at Desnoeufs, 23rd January 2005. Habitat map from Spencer et al. (2009).

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INTRODUCTION

The Amirantes group, Seychelles, comprises 24 islands and islets lying between 5° and 6° south of the equator on the Amirantes Bank, western Indian Ocean. The islands were discovered by the Portuguese navigator Vasco de Gama on his second voyage to India in 1502, soon after acceding to the rank of Admiral, and the islands were subsequently named Ilhas do Almirante or Admiral's Islands. Desnoeufs was the fifth island located by the Chevalier du Roslan in 1771 and he named it Ile des Neufs (Lionnet, 1970). It is the most southerly of the main group of Amirante islands, 138 km from the reefs and shoals of African Banks at the northern end. It lies 13 km south-west from its nearest neighbour in the Amirantes, the island of Marie-Louise and 290 km southwest of the island of Mahé in the granitic Seychelles.

Desnoeufs was described as being well-wooded by the du Roslan Expedition in 1771 (Wilson, 1983). Today (2005) it is not wooded but it is well vegetated, a contrast to Baker's observations in 1960 when he reported an island surface 'bare of vegetation except for a small clump of littoral scrub on the sand by the landing place' (Baker, 1963). In the mid-1900s, Marie-Louise developed both agriculture and guano production and it is thought that in these early days, Desnoeufs was run in a similar way, with the removal of 100 tonnes of guano, although agricultural production was much less successful than on the neighbouring island (between 1900 and 1910, about 300 pigs were free-ranged on the island (Wilson, 1983)). Five coconut palms were planted on Desnoeufs in 1900 (Ridley and Percy, 1958) and rows of pits indicate that there were once plans to develop a coconut plantation on the island but these never came to fruition. The original coconut palms are still standing on the island and were observed as the only trees on the island in 2005, with the exception of a single Hibiscus tree. Wilson (1983) speculated that, under guano exploitation, the almost complete removal of the littoral hedge at the same time as the removal of the natural woodland cover exacerbated the difficulty of tree regeneration. This in turn allowed the expansion of ground-nesting seabird colonies and the

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Manuscript received 15 October 2009.

development of vegetation communities which favoured seabird breeding, thus leading to the intensive egg harvesting which continues to this day. In particular, the *Sterna fuscata* (Sooty Tern) colony on Desnoeufs is remarkable; on the basis of observations from mid-June to mid July in 1979 and 1980, Wilson (1983) estimated the maximum number of pairs on the island at any one time as lying between 844,800 and 1,195,000.

There are a small number of huts near the landing point on the north of the island. This small settlement is utilised by workers of the Island Development Company (a government parastatal which took over ownership of the island in 1981) when they visit Desnoeufs between May and August to collect seabird eggs (mostly of *Sterna fuscata* (Sooty Tern)) which are sent to Mahé for the local market. Desnoeufs is the only island in the Seychelles where egg collection still occurs in this official capacity. Stoddart (1984a) attempted to summarize the cropping of Sooty Tern eggs in the Seychelles between 1928 and 1974, showing Desnoeufs as the key supplier. During the period 1944 -1965, 1.07 million eggs reached Mahé from the outer islands of which Desnoeufs supplied an annual average of 0.77 million. However, in 1943, 1.86 million eggs were taken from the Amirantes and in 1931, the peak year on record, 5.1 million eggs were taken. A closed season for collecting was first established in 1933 and between 1956 and 1961 Desnoeufs was only cropped in alternate years. That system has now been replaced by annual cropping but with area controls. The western side of the island, an area of about 16.6 ha, is designated as a strict Nature Reserve from which no eggs can be collected. In addition, crate sizes have been reduced, so as to take 400 rather than 750 eggs, and Department of Agriculture staff monitor the collections. Nevertheless, cropping levels remain high. In 1979, 1,037,600 eggs and in 1980, 723,000 eggs were reported to have been taken from the island (Wilson, 1983). In 2005, 1 million eggs (including those sold, given free of charge and broken during collection) were removed from Desnoeufs (Ministry of Environment, Seychelles, pers. comm., 2005).

Strong, but non-linear, relationships have been found between percentage vegetation cover and *Sterna fuscata* nest density at Desnoeufs; in late June – early July 1995, egg densities peaked at over 4 eggs per square metre at around 40% vegetation cover. Vegetation communities of *Portulaca oleracea* in association with bare ground and/or sparse *Stachytarpheta jamaicensis* typically supported over five nests per square metre and communities composed of *Boerhavia* sp. associated with varying combinations of bare ground, *P. oleracea* and sparse *S. jamaicensis* supported over three nests per square metre. By contrast, monospecific stands of *Cyperus ligularis* supported less than one nest per square metre and where there was dense *S. jamaicensis* there were almost no nests at all (0.05 ± 0.05 m^{-2}) (Feare et al., 1997). Sooty Terns modify vegetation by trampling around nest sites, and by seawater and faecal deposition; in undisturbed communities these processes can be active for a period of five months. However, as disturbance of breeding colonies by repeated egg collecting causes the colony to be abandoned after approximately two months, the influence of the birds on the vegetation is diminished and it is able to regenerate. The growth of tall vegetation inhibits nest-site recognition and increases injury risk to chicks returning to nest sites; fledgling success rates can, therefore, be tied to vegetation type, with the highest success rates in areas dominated by *Portulaca oleracea*. In addition, rabbits (*Oryctolagus cuniculus*) have co-existed with nesting seabirds at Desnoeufs for at least 60 years and it is thought that rabbits help retain herb vegetation in a condition attractive to the birds between breeding

seasons (Feare et al., 2007). In 1979-80 rabbits were common, ranging over the whole island (Wilson, 1983), and they were also observed in 2005.

Harvesting of Sooty Tern eggs at Desnoeufs is likely to have led to the harvesting and disturbance of other seabird species. In the past, *Sula dactylatra* (Masked Booby) have been observed at Desnoeufs, with a population of 100-450 pairs being noted in the 1950s and 1960s (Ridley and Percy, 1958; Bailey, 1968). However, in October 1976 there were only 17 occupied nests (Feare, 1978) with 18 nests in June 1979 and only 8 nests in July 1980 (Wilson, 1983). Despite these birds being protected by law and the colony being within the designated nature reserve, egg collectors have often been noted to take masked boobies for their own consumption (Feare, 1978). Similarly, around 20 pairs of *Sula leucogaster* (Brown Booby) were observed in July/August 1955 (Ridley and Percy, 1958). However, in October 1976 and July 1979 only three occupied nests were observed (Wilson, 1983). No Boobies were seen at Desnoeufs in January 2005. In contrast, several thousand pairs of *Puffinus pacificus* (Wedge-tailed Shearwater) were found in burrows around the entire island perimeter in June 1979 and July 1980. Shearwater chicks are cropped annually between February and March, with around 2,000 being shipped to the granitic Seychelles each year (Wilson, 1983).

Neither H.M.S. *Alert* in 1882 (Coppinger, 1885), nor the Percy Sladen Trust Expedition of 1905 (Gardiner and Cooper, 1907) landed at Desnoeufs, citing the difficulty of getting ashore through a heavy surf and the lack of a suitable anchorage respectively. The geology (Baker, 1963) and soils (Piggott, 1968, 1969) were described in the 1960s and eight island vegetation communities described, and sight records of 30 species of vascular plants recorded in 1979-1980 (Wilson, 1983). The Netherlands Indian Ocean Programme expedition to the Seychelles onboard R.V. *Tyro* called at Desnoeufs in January 1993. 1 SCUBA survey (reef-slope) and 1 snorkel survey (reef-flat) were conducted on the northern side of Desnoeufs and a 3.5 m Agassiz trawl used to survey the deep (54 m) central Amirantes Bank, at a location 8 km due north of the island (van der Land, 1994).

A collaborative expedition between Khaled bin Sultan Living Oceans Foundation, Cambridge Coastal Research Unit and Seychelles Centre for Marine Research and Technology – Marine Parks Authority to the southern Seychelles was conducted onboard M.Y. *Golden Shadow*, from 10th – 28th January 2005. The primary aim of the expedition was to use a CASI (Compact Airborne Spectrographic Imager) sensor onboard a seaplane to conduct large-scale mapping of the southern Amirantes, Alphonse/St. Francois (Spencer et al., 2009) and Providence Bank. All surveys at Desnoeufs took place on 23rd January 2005.

TOPOGRAPHY AND GEOLOGY

Of the seven reef types identified in the Seychelles by Stoddart (1984b), three are present in the Amirantes: platform reef, atoll and drowned atoll. The platform reefs vary in their morphology; Spencer et al. (2009) identified three categories of platform reef. They defined Desnoeufs as a Type 2 platform reef, where the reef island is surrounded by a narrow peripheral reef but where both island and reef sit on an extensive and relatively shallow and gently sloping rock platform covered in rubble, sand and seagrass beds,

often incised by numerous small, sub-parallel and anastomosing channel systems (Plate 1). Table 1 provides quantitative information on this morphology; it can be seen that the island accounts for less than 10% of the total reef platform surface area, as is the case at Marie-Louise (where the island accounts for 9.36% of a total reef platform area of 7.89 km^2 (Spencer et al., 2009)).

Table1. Morphometry of the platform reef at Desnoeufs.

Total reef platform area[1] (km^2)	Peripheral reef area[2] (km^2)	Land area[3] (km^2)	Land area as proportion o total reef platform area (km^2)
5.93	0.24	0.48	8.14

[1] area of terrestrial and shallow marine habitats classified by Spencer et al. (200 from airborne imagery

[2] area between the breaker zone and island marginal sediments

[3] area of terrestrial habitats and coarse beach materials (including beachrock)

Desnoeufs sits at the eastern margin of an oval-shaped area of shallow water depths of less than 20 m; water depths immediately to the west are 8-12 m. To the north, an extensive area with water depths of 24 – 27 m characterizes the southern end of the Amirantes Bank whilst to the south, water depths rapidly exceed 1,000 m. The island at Desnoeufs is roughly circular, with a land area of 39.7 ha. It is characterized by a core of sandstone which spreads out in concentric rings from a centre approximately 100 m in diameter (Baker, 1963; Piggott, 1968, 1969). The surface of the island is a basin, being approximately 2 m above sea level at its centre, but with marginal rims at around + 4.5 to + 5 m. Sandstones inland have become phosphatised to varying degrees and unconsolidated calcareous gravels and sands have been reported to underlie this rock. Parts of the island margin are formed of phosphatic sandstone and cliffed on its seaward side, especially on the east coast. The island has extensive guano deposits and the soils are formed from guano and wind-blown sand. Baker (1963) estimated that the guano was 20 cm deep, but this is not evenly spread across the island. The Desnoeufs Series soil is typically a phosphate-rich, dark brown humus, derived from material imported by seabirds rather than being a weathering product from the underlying, partially phosphatised sandstone. Windblown sand forms low dunes on the least exposed north-eastern and south-western coasts; on the more exposed north-western and particularly south-eastern coasts, windblown sand forms thin sand sheets, extending inland and characterized by shallow organic soils of the Farquhar Series (Wilson, 1983; Piggott, 1968, 1969). Beaches are poorly developed on the eastern side of the island but are much better developed in the north and west (Plates 2-5) and at the time of the January 2005 expedition, reached a maximum extent in the southwest. A small, sandy reef-flat surrounds the south and south-west of the island (~200 m at its widest), with the central section being colonized by high density seagrass beds (Fig. 1).

METHODS FOR TERRESTRIAL SURVEYS

Terrestrial Flora and Fauna

Vegetation surveys were conducted using the Line Intercept Transect (LIT) technique over a horizontal distance of 30 m. By summing the intercept lengths for each plant species and dividing this value by the total length of the transect, percentage cover for each plant species was calculated:

$$\text{Percentage cover} = \frac{\text{Total length of plant species}}{\text{Length of transect}} \times 100$$

Two LITs were conducted at Desnoeufs, one in the north of the island (DV1) and one in the west (DV2) (Fig. 1). The short length of these LITs was due to the opportunistic nature in which the work was being undertaken and limited time available (an average of about 3 hours was spent conducting the LITs and making plant observations). Plants that could be not identified *in situ* were labelled and photographed with a high resolution (4.1 mega pixels) digital camera for later identification by local botanists Murugaiyan Pugazhendhi and Katherine Beaver. General observations of the island, bird-life and plant-life were also recorded.

Two dry-stored insect sample vials were collected. The species were identified by examination under low magnification and consultation of relevant taxonomic works, identification keys and specimens from other localities.

Beach Surveys

Three beach profiles were conducted at Desnoeufs on the west (transect DB1; 6°14.173′S, 53°02.397′E - 6°14.184′S, 53°02.363′E), south-east (DB2; 6°14.125′S, 53°02.797′E - 6°14.130′S, 53°02.806′E) and north-east (DB3; 6°13.949′S, 53°02.717′E - 6°13.937′S, 53°02.724′E) coasts (Fig. 1). Profiles were measured by Abney level and tape, in an offshore direction perpendicular to the beach, beginning at the terrestrial vegetation line and continuing to the offshore step (where the waves were breaking, typically marked by a downward step) or as far as safely possible into the water. Two surface scrape sediment samples of *ca.* 200 – 350 g by weight were collected from Desnoeufs, from profile DB2 and profile DB3. Positions, fixed using a hand-held GPS unit (horizontal resolution = ±10 m), were recorded for the start and end of each beach profile and for the sites of the sediment samples. Sediments were dried, disaggregated and sieved using standard techniques at 0.25 phi intervals.

METHODS FOR MARINE SURVEYS

Shallow-water Boat Transects

A rigid inflatable boat was used to conduct shallow-water transects at four sites around Desnoeufs. Transects started in deep water and ran in towards a pre-decided point on the land. Transects ran approximately N-S (DSW1; 6°13.573'S, 53°02.708'E - 6°13.726′S, 53°02.758′E), W-E (DSW2; 6°14.363′S, 53°01.598′E - 6°14.213′S, 53°02.252′E), S-N (DSW3; 6°14.690′S, 53°02.589′E - 6°14.506′S, 53°02.636′E) and SE-NW (DSW4; 6°14.012′S, 53°03.507′E - 6°13.934′S, 53°03.217′E) (Fig. 1).

Transects were started at a water depth of approximately 20 m, the limit at which the bottom substrate could be accurately determined from the surface. Each time the boat was stopped a GPS position was taken and the water depth and bottom substrate (viewed through a glass-bottomed bucket) recorded. Ten substrate observations were recorded on transect DSW1, 18 on transect DSW2, 6 on transect DSW3 and 11 on transect DSW4. No SCUBA diving surveys were undertaken at Desnoeufs due to time constraints.

RESULTS OF TERRESTRIAL SURVEYS

Flora and Fauna Surveys

The first vegetation Line Intercept Transect on Desnoeufs (DV1, Fig. 1) was conducted in the north of the island in a north-south orientation just behind the small settlement on the island which is used by the Island Development Company workers during the bird nesting season. The area was mostly composed of low lying shrubs, dominated by *Stachytarpheta jamaicensis* (54% cover, Fig. 2), an extremely common introduced plant on many of the arid islands of the southern Seychelles (Stoddart and Fosberg, 1984). On Desnoeufs it was introduced sometime between 1900 and 1955; and it had not developed the dense coverage seen today (2005) in parts of the island by 1955 (Ridley and Percy, 1958). It is now strongly associated with the areas in which egg collecting takes place (Feare et al., 1997). *S. jamaicensis* was often found inter-mixed with *Portulaca oleracea* (which accounted for 30% cover) (Fig. 2). An unidentified creeping grass was also found to be relatively common (14% cover) often occupying open areas between *S. jamaicensis* and *P. oleracea.* These three species were the only species found along this transect.

The southern side of the island is more exposed to the south-east trades, and the thin sand sheets are dominated by low lying vegetation. Following surveys in 1979 and 1980, Wilson (1983) described an island margin community dominated by *Stenotaphrum micranthum*. The second transect (DV2) was conducted on the southwest of the island in a west-east orientation (Fig. 1). The south-west side of the island appeared to be more exposed to the wind, and thus was dominated by low lying vegetation such as an unidentified creeping grass (38% cover) which often formed large mono-specific stands.

Portulaca oleracea was the second most dominant species found occupying 26% of the transect line followed by the erect grass *Dactyloctenium ctenoides* (23% cover) and *S. jamaicensis* (7% cover, Fig. 2). The creeper *Passiflora suberosa* was also observed but exhibited very low coverage (0.5%).

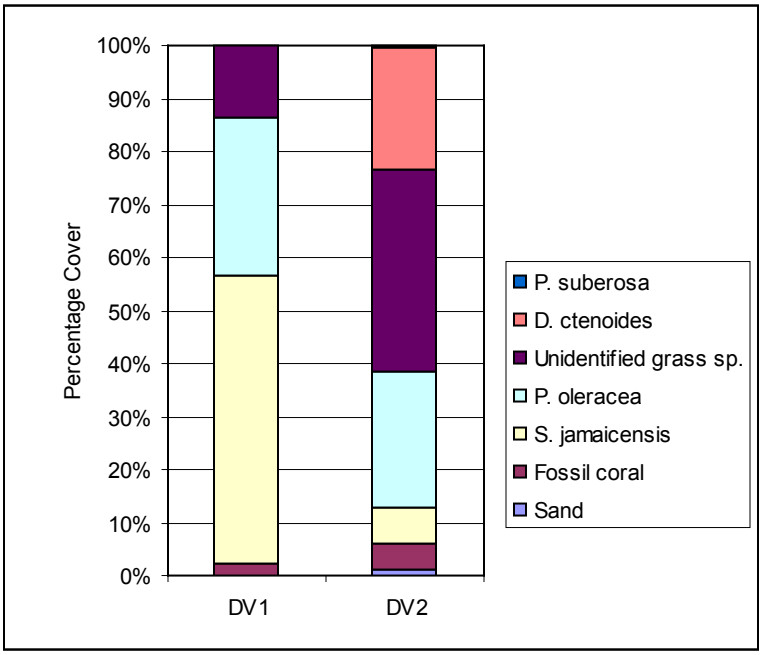

Figure 2. Percentage cover of plant species along two 30 m long LITs at Desnoeufs, January 2005 (see Figure 1 for locations of DV1 and DV2).

Large areas of a sheltered mixed herb community (Wilson, 1983), including the white flowered *Catharanthus roseus* (Madagascar periwinkle) (Plate 6) and *Acalypha indica*, were found in 2005 in the vicinity of the settlement, mixed with *S. jamaicensis* and *Ipomoea pes-caprae*. The northern fringe of the island supports a littoral hedge of *Scaevola taccada* (Plate 7) which is interrupted by the settlement buildings. Large areas of the sedge *Cyperus ligularis* (around 1 m tall) were found in the centre of the island (Plate 8). Other plants observed included *Cocos nucifera* (coconut palm), *Gossypium hirsutum* (cotton), *Morinda citrifolia* (Indian mulberry), *Desmanthus virgatus, Colubrina asiatica, Hibiscus tiliaceus* (Plates 8 and 9) and *Nicotiana tabacum* (tobacco), most probably introduced by island workers. A full list of plant species observed at Desnoeufs in January 2005 is displayed in Table 2.

Birds were observed nesting in the large, central *Hibiscus tiliaceus*. The following bird species were observed at Desnoeufs; *Sterna fuscata* (Sooty Tern), *Sterna anaethetus* (Bridled Tern), *Anous tenuirostris* (Black or Lesser Noddy), *Bubulcus ibis* (Cattle Egret), *Gygis alba* (Fairy or White Tern), *Anous stolidus* (Brown or Common Noddy), *Fregata minor* (Greater Frigatebird) and 'cardinals' (*Foudia* spp.). Crabs (*Grapsus* spp.) and hermit crabs, lobster shells and turtle nests (probably of *Eretmochelys imbricata*) were observed on the beaches and rabbits (*Oryctolagus cuniculus*) were observed in the undergrowth.

Table 2. Scientific and Creole / common names of plants observed at Desnoeufs, January 2005. Total number of plants observed = 24. Number of new records compared to Wilson (1983) = 7 (new records marked with *).

Family and Species	Creole / Common Name
Apocynaceae	
Catharanthus roseus	Roz enmer / Madagascar periwinkle
Arecaceae (Palmae)	
Cocos nucifera	Cocotier / Coconut palm
Convolvulaceae	
**Ipomoea pes-caprae*	Batatran / Goats foot creeper / Beach morning-glory
Cyperaceae	
**Cyperus aromaticus*	Sedge
**Cyperus dubius*	Sedge
Cyperus ligularis	Herbe bourique
Euphorbiaceae	
Acalypha indica	Herbe chatte / Lerb sat / Cat grass
Phyllanthus amarus	
Fabaceae (Leguminosae)	
**Desmanthus virgatus*	Wild tantan
**Leucaena leucocephala*	Kasi
Goodeniaceae	
Scaevola taccada	Scaevola
Malvaceae	
**Gossypium hirsutum*	Cotton
Hibiscus tiliaceus	Var / Mahoe
Nyctaginaceae	
Boerhavia sp.	Pata covin / Patate cauvin
Passifloraceae	
Passiflora suberosa	
Poaceae (Gramineae)	
Dactyloctenium ctenoides	Grass
Unidentified grass sp.	Grass
Portulaceceae	
Portulaca oleracea	Kour pye / Pourpier / Morning glory
Rhamnaceae	
Colubrina asiatica	
Rubiaceae	
**Morinda citrifolia*	Bois tortue / Indian mulberry
Solanaceae	
Datura metel	Wild aubergine
Nicotiana tabacum	Tobacco
Solanum nigrum	
Verbenaceae	
Stachytarpheta jamaicensis	Épi bleu

Collection of insects at Desnoeufs was considerably reduced due to time constraints and only the following two insects were identified:

1. *Aiolopus thalassinus rodericensis* (Butler, 1876).
Order Orthoptera, family Acrididae, subfamily Acridinae.
This sub-species of grasshopper is found only in the western Indian Ocean (Madagascar, Réunion, Mauritius (including Rodrigues) and Seychelles (both granitic and coralline islands).

2. Unidentified stink bug. Order Heteroptera, family Pentatomidae.
Further work is required to identify this specimen.

Beach Surveys

Beaches on Desnoeufs are typically backed by reef sandstone deposits around the majority of the island's periphery. The eastern and northern beaches are composed of well sorted coarse sand (DB3) to moderately well sorted very coarse sand (DB2) (Table 3, Fig. 3). Textural groups represented are slightly gravelly to gravelly sand. On the western side of the island, beach widths are typically 40 – 50 m in width, and are footed by an extensive rock pavement; towards the south the beach widens to 80 – 90 m. Profile DB1, just to the north of the widest expanse of beach on Desnoeufs, shows a total beach width of over 80 m, comprising a narrow seaward beach, at angles of 4 - 6 ^{o}, rising to a berm at 2.6 m above the base of the beach, followed by a 50 m wide back-berm trough which abuts against the rocky island margin (Fig. 4a). The northern end of the western beach is interrupted by shore-normal ridges of beachrock, phosphatic rock and linear boulder ridges (Plate 4). On the southern side of the island the narrow (< 30 m wide) beach is footed by slabs of coastal phosphatic rock which mark the boundary with a 170 m wide sandy reef-flat (Plate 5). To the southeast and east, beaches form pockets within areas of boulders and a littoral rock pavement of phosphatic reef sandstone (Plate 2). Profile DB2 on the eastern margin shows a narrow (< 25 m), steep (mean = 7^{o}, range: 4 – 11^{o}) beach (Fig. 4b). On the northern side of the island, profile DB3 shows very similar characteristics to the eastern beaches, being narrow (26 m) and similarly steep (mean = 8^{o}, range: 4 – 19^{o}) (Fig. 4c). The beach here grades offshore into fore-reef sands.

RESULTS OF MARINE SURVEYS

The island of Desnoeufs sits on the northern margin of an extensive rock platform characterized by a radiating pattern of numerous narrow, sand-filled lineations. There is a well-defined, E-W trending boundary to the rock platform which lies just north of the island (Fig. 1). The area to the north of this boundary is characterized in equal measures by fore-reef slope sand, low density seagrass, and, to the northwest, areas of high density seagrass. The northwestern boundary of the rock platform is also characterized by a strip of medium density seagrass.

Table 3. Folk and Ward (1957) particle size distribution statistics for sediment samples from eastern (DB2) and northern (DB3) beach profiles. Units are given on the phi (ø) scale.

Sample	Environment	D_{50}	M_z	σ_1	SK_1	K_G	Description
DB2	Eastern beach	-0.103	-0.149	0.662	-0.172	1.232	Very Coarse Sand, Moderately Well Sorted, Coarse Skewed, Leptokurtic
DB3	Northern beach	0.704	0.691	0.361	-0.061	1.015	Coarse Sand, Well Sorted, Symmetrical, Mesokurtic

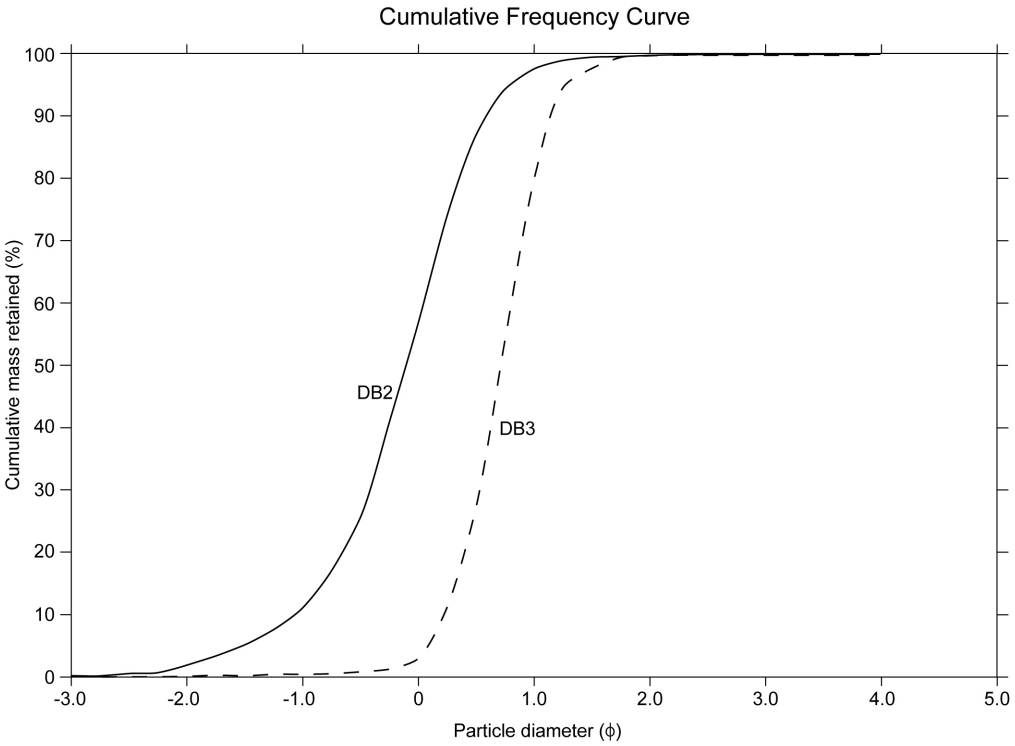

Figure 3. Cumulative frequency curves for sediment samples from eastern (DB2) and northern (DB3) beach profiles.

Shallow-water Transects

Benthic observations were made on the north side of the island from a depth of 16 m to 6 m, over a distance of approximately 0.5 km (DSW1, Fig. 1). At 16 m, the substrate was bare sand, but this gave way to dense *Thalassodendron ciliatum* seagrass beds between 15 m and 16 m. At 14 m depth, bare sand was observed and at 12 m, *T. ciliatum* seagrass. At 10 m water depth the substrate was composed of rubble on sand and only at the shallowest observation, 6 m water depth, was any live coral observed. Here there was a small amount of *Acropora* spp. and *Pocillopora* spp. on a rock pavement, interspersed with rubble.

On the western side of the island, observations were made between 17.5 m depth and 2.1 m depth, across a distance of approximately 1 km (DSW2, Fig. 1). Between 18 m water depth and 7 m water depth, the substrate comprised rubble on sand, interspersed with small live branching corals, typically *Pocillopora* spp. and between 7 m and 6 m, live coral was observed on coral rock. The substrate was separated by a sand channel at 5 m, before giving way to a large bed of *Thalassodendron ciliatum* seagrass at 4 m water depth. Shallower than 4 m, coral rock was prevalent, interspersed with live branching corals.

Observations on the south side of the island showed a lack of seagrass beds and here, all observations were recorded as ‘coral on coral rock’ between water depths of 18 m and 6 m, over a distance of approximately 0.5 km (DSW3, Fig. 1).

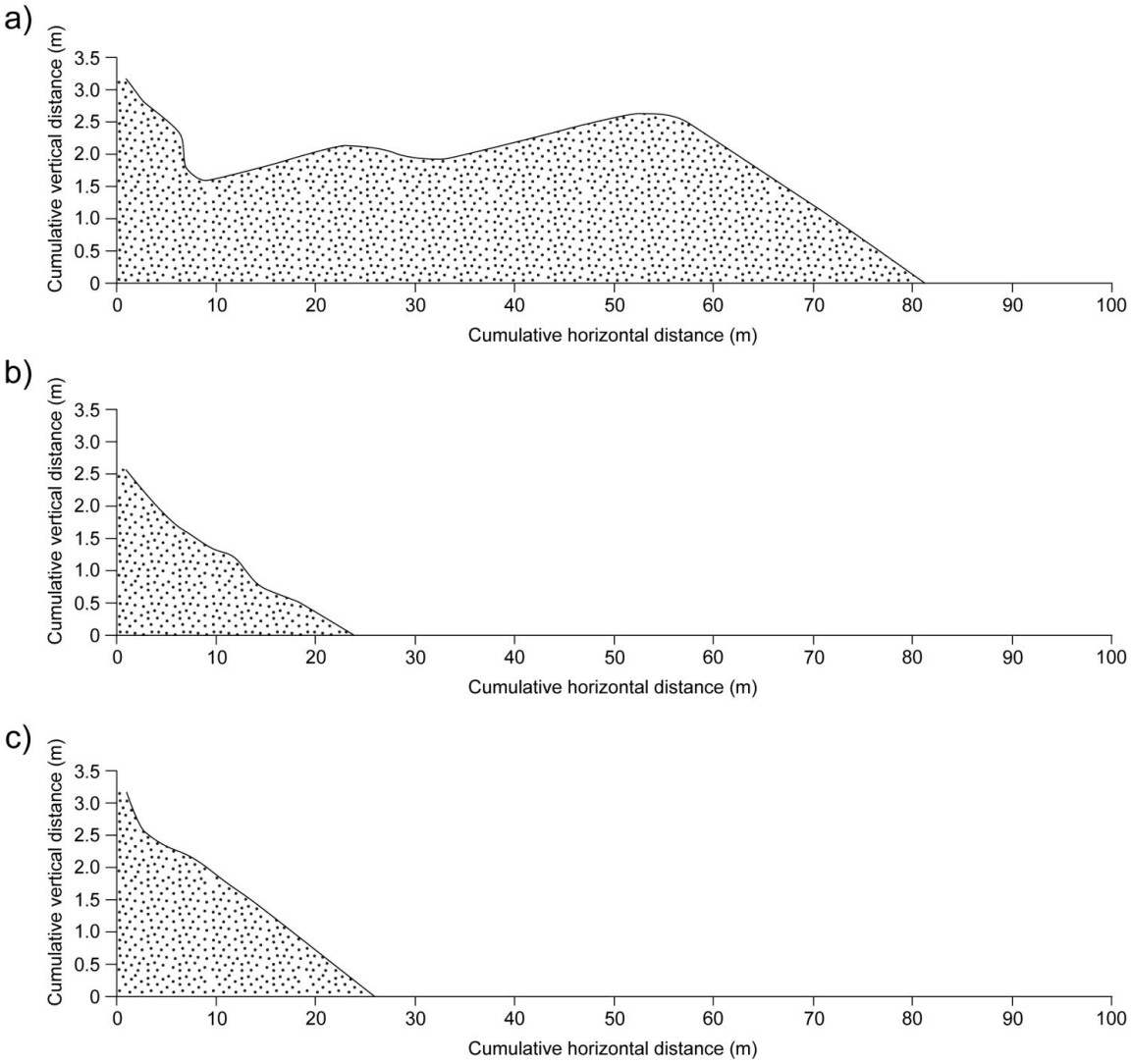

Figure 4. Beach profiles a) south-west side of the island at 6°14.173′S, 53°02.397′E - 6°14.184′S, 53°02.363′E; b) south-east side of the island at 6°14.125′S, 53°02.797′E - 6°14.130′S, 53°02.806′E; c) north-east side of the island at 6°13.949′S, 53°02.717′E - 6°13.937′S, 53°02.724′E.

On the eastern side of the island, observations were made between 17 m and 6 m water depths over a distance of approximately 0.6 km (DSW4, Fig. 1). All observations at depths greater than 10 m recorded ‘coral on coral rock’, with the coral at these depths being typically small branching colonies. A small patch of rubble was observed at 16 m depth. Shallower than 10 m, bare coral rock was recorded.

DISCUSSION

Terrestrial Surveys

During the short visit (approximately 3 hours) to Desnoeufs in January 2005, 24 plants were observed. This is over three-quarters of the number of plant species identified by Wilson (1983) over a period of 25 days at Desnoeufs (Wilson (1983) identified 30 species in total). Seven of the 24 plants observed in 2005 are new records. 16 species were identified by both Wilson (1983) and the 2005 expedition but Wilson (1983) identified a further 14 species that were not observed by the 2005 expedition. Both of Wilson's (1983) visits were during the south-east trade-winds, a period during which the island usually suffers serious drought and is continually exposed to salt spray, bird droppings and trampling by nesting seabirds. During the 2005 visit to Desnoeufs, the island was green with plenty of water and the vegetation was undisturbed by nesting seabirds. The vegetation was dominated by a few of the more opportunistic plant species, with most of the common plants being recorded. It would be expected that more plant species would be observed during these wetter, undisturbed months, but due to the incredibly brief visit ashore (~ 3 hours) a comprehensive plant survey could not be undertaken. Many of the new species observed during 2005 are herbs that could be considered as seasonal transients.

It would be interesting if new vegetation surveys could be undertaken during the bird nesting season under comparable conditions as those encountered by Wilson (1983). This would give some indication as to whether observed differences in the plant community were due to seasonal differences in climate, the presence or absence of birds, longer term changes from inter-annual climatic variability or long term changes in egg collecting and island management practices.

Marine Surveys

On the north and west sides of Desnoeufs, *Thalassodendron ciliatum* seagrass beds were more prevalent that coral reef but no seagrass beds were observed on the south or east side of the island, which were typified by coral rock pavement and small branching corals. Without conducting quantitative SCUBA surveys, it is difficult to comment on the state of the limited amount of reef at Desnoeufs at the present time. However, the large expanses of coral rock and dominance by the branching coral *Pocillopora* spp. on the south and east sides of the island may indicate that the coral bleaching event of 1997-98 which devastated the reefs of the Seychelles (Lindén and Sporrong, 1999; Spencer et al., 2000) had an effect on the reefs here. *Pocillopora damicornis* has been described as an opportunistic species, due to its rapid reproductive cycle, widespread larval dispersal and fast growth rate on settling, enabling it to quickly occupy any newly available space (Endean and Cameron, 1990) such as that available following the 1997-98 coral bleaching event in the Amirantes group. *Pocillopora* spp. colonies at Desnoeufs typically measured 10-30 cm in diameter, sizes which could have been attained in the 7 years following the bleaching event.

However, the Netherlands Indian Ocean Programme expedition conducted one SCUBA transect on the northern reef-slope of Desnoeufs (6°13′S, 53°01′E) on 2nd January 1993 and found that live coral cover constituted only 9% of the benthos. This small amount of live coral cover comprised 38% *Porites* spp., 24% pocilloporids and 6.1% *Stylophora mordax* (van der Land, 1994). No acroporids were recorded here. These previous surveys suggest that the reefs of Desnoeufs have never been well developed and have only ever exhibited a small amount of live coral cover.

ACKNOWLEDGEMENTS

Observations in the Republic of Seychelles were supported through a collaborative expedition between Khaled bin Sultan Living Oceans Foundation, Cambridge Coastal Research Unit, University of Cambridge and Seychelles Centre for Marine Research and Technology – Marine Parks Authority (SCMRT–MPA). The authors would like to acknowledge Prince Khaled bin Sultan for his generous financial support of the expedition and use of the M.Y. *Golden Shadow* and Capt. P. Renaud, Executive Director, Khaled bin Sultan Living Oceans Foundation for extensive logistical support. We also graciously acknowledge the encouragement, collaboration, and logistical support provided by the Seychelles Government and thank the Island Development Company, Seychelles, for permission to visit islands in the southern Seychelles. Laboratory analyses for the particle size distributions of beach sediments were undertaken by Chris Rolfe, Senior Laboratory Technician, Department of Geography, University of Cambridge; statistics were obtained through the 'Gradistat' package (© S. Blott). We are extremely grateful to Murugaiyan Pugazhendhi and Katherine Beaver for help with vegetation identifications, David Stoddart and Lindsay Chong-Seng for help with vegetation listings, and Sarah Hamylton for providing Figure 1.

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PLATES

Plate 1. Desnoeufs looking northeast. Note edge of rock platform and seagrass and sandsheets to the north, and reef flat and breaker zone to the south, of the cay (photograph: Herb Ripley, January 2005).

Plate 2. Littoral rock pavement of phosphatic sandstone on east coast (photograph: Jen Ashworth, January 2005).

Plate 3. Dark brown phosphatic sandstones and overlying carbonate sand and boulder beach on east coast. The island of Marie-Louise can be seen in the distance (photograph: Jen Ashworth, January 2005).

Plate 4. Steep upper beach of carbonate sands, lower boulder beach and beachrock ledges at water level on north coast, near the landing site. Note beach crest community of low herbs (photograph: Jen Ashworth, January 2005).

Plate 5. Slabs of coastal phosphatic rock on south-west coast (photograph: Jen Ashworth, January 2005).

Plate 6. Sheltered mixed herb community, with *Catharanthus roseus* (Madagascar periwinkle), behind the littoral hedge in the north of the island, close to the settlement (photograph: Jen Ashworth, January 2005).

Plate 7. *Scaevola taccada* littoral hedge on less exposed section of north coast (photograph: Jen Ashworth, January 2005).

Plate 8. *Cyperus ligularis* in the centre of the island, with large *Hibiscus tiliaceus* back left and coconut palms back right (photograph: Jen Ashworth, January 2005).

Plate 9. Typical protected area vegetation community of low, open mosaic of mixed herbs with large *Hibiscus tiliaceus* in the centre of the island (photograph: Jen Ashworth, January 2005).