

11. ECOLOGY OF DESNOEUF'S, AMIRANTES ISLANDS

by J. R. Wilson

Introduction

Desnoeufs (6°14'S, 53°02'E) is the southernmost of the Amirantes. It is situated 13 km from its nearest neighbour, Marie-Louise, and 290 km from Mahe in the granitic Seychelles. It is roughly circular (Figure 12) with an area of 39.7 ha and a maximum elevation of 4 m on its slightly raised perimeter. There is one safe landing on the beach in the north behind which a number of huts have been erected to house a workforce of around 30 men stationed on the island each year from May to August to collect seabird eggs. A reserve of 16.6 ha has been established on the western side.

Desnoeufs has received several visits by scientists over the past 25 years. Percy and Ridley (1958) described the natural history in detail and there have been a series of subsequent censuses of the sooty tern colony (Feare 1976, Percy and Ridley 1966, Procter 1970). The geology and soils have also been examined (Baker 1963, Piggott 1968) with particular emphasis on the guano deposits. The observations presented here were made during two visits to the island, during 15-24 June 1979 and 18 July-1 August 1980.

Geology and soils

The island is believed to be an uplifted cay in which sandstone, originally formed as beach rock, spreads outwards in concentric rings from a centre approximately 100 m in diameter (Piggott 1968, 1969). Beachrock formation continues on the shore whilst the older sandstones inland have become phosphatised to varying degrees and on parts of the south coast fragments of this dark brown phosphatised material have been reincorporated in the more recent beds. Unconsolidated calcareous gravels and sands underlie the rock.

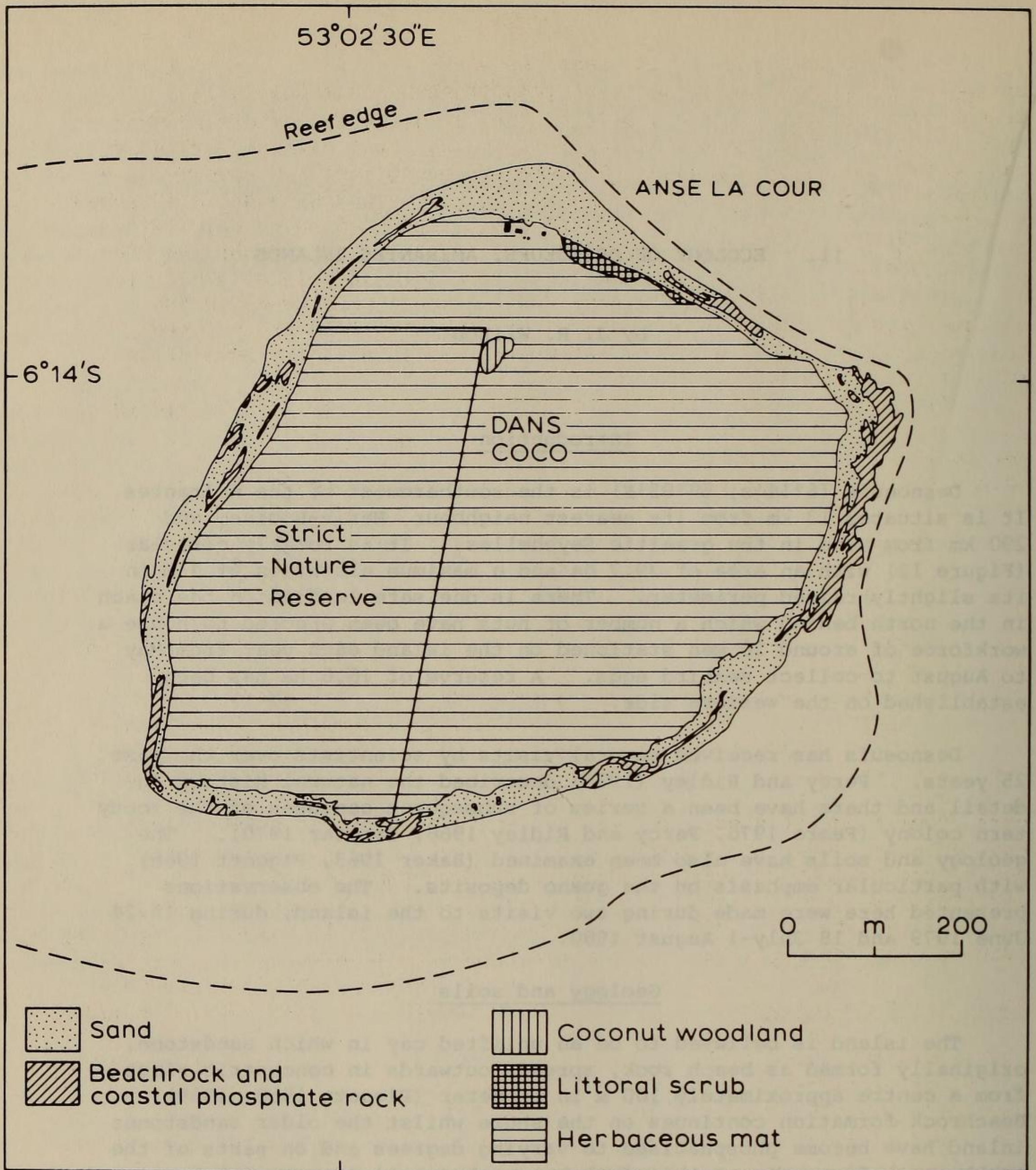


Figure 12. Desnoeufts

The soils are formed from guano and wind-blown sand. Baker (1963) estimated that the average depth of guano was approximately 20 cms but it is not evenly distributed and rock is widely exposed. The guano is the type for the Desnoeufts series soil (Piggott 1968), a richly phosphatic dark brown humus overlying the partially phosphatised sandstone and principally derived from material imported by seabirds with little contribution from the underlying rock. A structureless pink skin occurs on the surface of occupied and abandoned booby colonies.

Windblown sand forms low dunes which are best developed on the northeast and southwest coasts whilst on the northwest and southeast, the coasts facing directly into the two prevailing winds, the sands extend further inland and are thinly spread. Farquhar Series soils develop. Typically these consist of a shallow organic horizon grading through to pure sand at about 30 cms (Piggott 1968) but on Desnoeufts they have a particularly high phosphatic content and the organic material is mixed to greater depth because of extensive burrowing by wedge-tailed shearwaters.

Vegetation

The island is generally clothed in coarse herbage although there is a small coconut grove, a single *Hibiscus* tree and a short stretch of coastal hedge. Eight vegetation communities were distinguishable on the basis of structure and species content but it was evident that considerable seasonal changes took place and that the herb communities described here were transient. During the wetter northwest monsoon when the sooty terns are absent the ground vegetation is said to be luxuriant (O. Souris, pers. comm.) but it dies back over the south east trades between April and September under the combined effects of drought, exposure to salt spray, trampling by seabirds and accumulation of fresh droppings. The vegetation was considerably more open and community boundaries less distinct in late July 1980 than was the case in June 1979 and it has been assumed that these changes are essentially similar each year.

Beach crest community

A discontinuous cover of prostrate species including *Lepturus repens*, *Portulaca oleracea*, *Stenotaphrum micranthum*, *Sida parvifolia*, *Euphorbia prostrata* and *Boerhavia* sp. occurs on the beach crest. In June the community is generally confined to a strip ca 1 m wide although extending several metres inland in more exposed sites on the south coast. Later in the year it partially spreads into the area opened up by the reduction in cover of the dune community.

Dune community

In June the vegetation of the Farquhar Series soils is dominated by *Stenotaphrum*. To the north it forms a dense sward, also containing *Phyllanthus amarus* and *Passiflora suberosa*, whilst in the south the thinner soils bear a shorter, sparser *Stenotaphrum* sward mixed with *Portulaca*, *Sida* and *Boerhavia*. Later the *Stenotaphrum* tends to die

back and *Boerhavia* becomes dominant or co-dominant. *Sida* and *Portulaca* remain common.

Dactyloctenium dominated transitional community

Behind the coastal ridge in the north and east lies a belt of soil transitional between the Farquhar and Desnoeufs Series. In June the area is dominated by withering *Dactyloctenium* sp. with scattered *Stenotaphrum*, *Stachytarpheta jamaicensis*, *Sida*, *Cleome gynandra*, *Portulaca* and *Boerhavia*. As the *Dactyloctenium* dies and becomes matted, *Stachytarpheta* and *Boerhavia* become more frequent.

South coast transitional community

A more floristically diverse variant of the dune community occurs inland along the south coast where the sand mixes with guano. *Stenotaphrum* is dominant and *Stachytarpheta* common in June but in July the *Stenotaphrum* dies back and *Boerhavia* and *Portulaca* become co-dominant.

Coastal hedge

A narrow, dense hedge of *Scaevola sericea* about 75 m long occurs along the least exposed section of the north coast. It is interrupted by the settlement buildings.

Sheltered mixed herb community

A mixed herb community grows behind the coastal hedge and extends c.100 m beyond it towards the east. Constituent species include *Phyllanthus amarus*, *Acalypha indica*, *Abutilon* sp., *Solanum nigrum*, *Amaranthus dubius*, *Stachytarpheta*, *Datura metel*, *Catharanthus roseus* and *Dactyloctenium*. These species were all present in June 1979, forming a dense sward up to 75 cm tall. *Phyllanthus* and *Dactyloctenium* were absent in July 1980 and the community was more open with the eastern extension, formerly dominated by *Stachytarpheta*, partially cleared allowing *Amaranthus* to persist and *Portulaca* to become dominant.

Coconut grove

A small coconut grove is found in the centre of the island. In 1979 it sheltered a similar community, with the addition of *Eleusine indica*, *Colubrina asiatica* and *Alocasia macrorrhiza*, to that found behind the coastal hedge but had been cleared in July 1980. Nevertheless the constituent species of the 1979 flora remained as scattered individuals.

Desnoeufs Soil community

This is not a homogenous vegetation type but a mosaic, the composition of which is seemingly determined by previous concentrations of seabirds, their present distribution, and the clearing activities of the egg collectors. In June 1979 *Stachytarpheta*, *Cyperus ligularis*,

Portulaca and *Amaranthus* all occurred in monospecific blocks or in mixed communities with occasional *Dactyloctenium*, *Solanum*, *Boerhavia* and *Cleome*. These latter species generally grew where the guano was mixed with sand or in small pockets of soil in loose sandstone blocks but *Abutilon*, *Sesbania* and *Datura* were scattered throughout the area. In July 1980 the vegetation was more open whilst a definite difference had developed between the reserve and the cropped area. The reserve, now densely occupied by breeding sooty terns, was dominated by open *Portulaca* with scattered *Cyperus* and *Boerhavia*. Occasional bushes of *Sesbania* and *Datura* were present but *Amaranthus* persisted only in areas with few nesting birds. *Stachytarpheta* dominated the area by the reserve boundary. In the cropped area *Stachytarpheta* was generally dominant whilst *Boerhavia* and *Portulaca* were common and *Cyperus* formed dense mono-specific blocks. Where the *Stachytarpheta* had been uprooted by egg-collectors, *Portulaca* sparsely covered the open ground.

A single *Hibiscus tiliaceus* tree forms a unique element in the Desnoeufs Soil vegetation mosaic.

List of plants

30 species of vascular plants were recorded after exhaustive search. The following are all sight records, although specimens were retained for verification in Mahe if a positive identification could not be made at the time. The names used here have been checked by F. R. Fosberg, and conform to those in others of this series of reports.

AMARANTHACEAE

Amaranthus dubius Mart. ex Thell.

Dominant or co-dominant with *Portulaca* on Desnoeufs soil, particularly within the reserve, but also found behind the coastal hedge and within the coconut grove. Apparently dies back earlier than *Portulaca*.

APOCYNACEAE

Catharanthus roseus (L.) G. Don

Common behind the beach hedge, in the coconut grove, and in sandy soils behind the dunes of the north coast. Only the white-flowering variety is found.

Neisosperma oppositifolia (Lam.) Fosb. and Sachet

The coastal hedge contains a single shrub which is healthy and fruiting but grows no higher than the surrounding *Scaevola*.

ARACEAE

Alocasia macrorhiza (L.) G. Don

Several yellowed specimens grow in pits on the fringe of the coconut grove.

ARECACEAE (PALMAE)

Cocos nucifera L.

About 30 planted trees form the grove in the centre of the island, and a small number of nuts sprout around the coast.

CAPPARIDACEAE

Cleome gynandra L.

Present behind the dunes on transitional soils or on the Desnoeufs soils proper. In June most frequent as a seedling or dying mature plants in the southern half of the island. Very few seedlings and no mature plants were located in July 1980.

CARICACEAE

Carica papaya L.

Several small plants were found in 1979 growing from seed thrown out from the camp into the lee of the coastal hedge. None remained in July 1980.

CONVOLVULACEAE

Ipomoea macrantha Roem. & Schultes

One plant was found on the dunes of the west coast in 1979 but was not present in the following year.

CYPERACEAE

Cyperus ligularis L.

Two large patches grow on the southwest and northeast of the island on Desnoeufs soil. Isolated tussocks occur elsewhere on the guano but are thinly distributed.

EUPHORBIACEAE

Acalypha indica L.

Frequent under and behind the beach hedge and within the coconut grove.

Euphorbia prostrata Ait. ?

Common on the beach-crest community and on the dunes wherever vegetation cover is discontinuous.

Phyllanthus amarus Schum. & Thonn.

Occasional in the north coast dune community but more frequent in the sheltered mixed herb community and among the coconuts.

FABACEAE (LEGUMINOSAE)

Sesbania sp. probably *sericea* (Willd.) Link

Isolated plants or groups of plants widely scattered over the central part of the island. In June 1979 most were dying back and in July 1980 only ten with living shoots remained.

GOODENIACEAE

Scaevola sericea Vahl

Limited to the coastal hedge on the north coast.

MALVACEAE

Abutilon indicum (L.) Sweet ?

Frequent in the Desnoeufts Soil community, the coconut grove, behind the beach hedge, and in 1980 on the edge of the dunes of the northwest coast. Most plants were dead, even in June.

Sida pusilla Cav.

Common within the dune community and on the beach crest.

Hibiscus tiliaceus L.

A single large tree grows on the Desnoeufts Soil near the centre of the island.

NYCTAGINACEAE

Boerhavia sp.

A white-flowered, fleshy trailing herb, most common on sandy soils around the perimeter of the island but well represented inland by July.

PASSIFLORACEAE

Passiflora suberosa L.

In 1979 two or three vigorous plants scrambled over *Stenotaphrum* in one small area of the dunes on the northwest coast. The following year these plants had spread to cover an area of about 3000 sq metres, and a single specimen was also located on the northeast coast.

POACEAE (GRAMINEAE)

Dactyloctenium ctenoides (Steud.) Bosser

Occurs primarily as a dominant species behind the dunes on transitional soils on the northeast and east sides of the island, but it is also present in the coconut grove and in the dunes of the west coast. Apparently dies back early during the southeast trades.

Eleusine indica (L.) Gaertn.

Most frequent behind the beach hedge and within the coconut grove, but in 1979 occasionally found elsewhere immediately behind the dunes.

Lepturus repens R. Br.

Found in small isolated patches as a primary coloniser of the beach crest, occasionally extending into the dune community behind.

Stenotaphrum micranthum (Desv.) Hubb.

In June *Stenotaphrum* dominates soils around the island perimeter and also inland where isolated patches of windblown sand overlies the phosphatic sandstone. By July it has generally died back but scattered plants still persist.

PORTULACACEAE

Portulaca oleracea L.

Found throughout the island in open areas but apparently suppressed by denser vegetation. It flourishes in those areas with the densest Sooty Tern concentrations, where it is generally dominant or co-dominant with *Amaranthus*.

RHAMNACEAE

Colubrina asiatica (L.) Brongn.

A dense and flourishing mass of bushes with several outliers grows in the coconut grove.

SOLANACEAE

Datura metel L.

Frequent in the coconut grove and in the sheltered mixed herb community but less common elsewhere on Desnoeufs Soil and absent from Farquhar Series soils.

Nicotiana tabacum L.

A single plant was found in the beach hedge in July 1980.

Solanum nigrum L.

Locally common throughout the Desnoeufs Soil area in June, but limited by July to the coconut grove and the shelter of the coastal hedge.

VERBENACEAE

Stachytarpheta jamaicensis (L.) Vahl

The most conspicuous herb on the island, occurring throughout the area of Desnoeufs Soil in dense monospecific patches or dominating in mixed communities, and also growing in soils transitional with the Farquhar Series.

ZYGOPHYLLACEAE

Tribulus cistoides L.

One localised patch consisting of less than ten plants was found in 1979 in the south coast transitional community. Several plants were pulled out by the egg collectors although seed had already been dropped. The site could not be relocated in 1980.

Vertebrate faunaReptiles*Hemidactylus* sp. (?*frenatus*)

A brown nocturnal gecko common in the camp buildings and also found in the coconut grove under blocks of sandstone.

? *Gehyra mutilata*

A number of paler, more translucent geckos were seen on the camp buildings in 1980 although they were not recorded in 1979. No specimens were collected and the identification is tentative.

Chelonia mydas

Green Turtle

Pits dug by nesting green turtles were divided into three categories according to age. Those that were eroded, partially infilled and invaded by vegetation were estimated as being older than 6 months, those with vegetation starting to invade and with surfaces smoothed to stable gradients were classed as 1-6 months old and those uninvaded by vegetation and with unstable surfaces were considered recent. Groups of pits of similar age were taken to be the result of one visit by a female. On this basis the traces of 48 visits over the past six months remained evident in mid-June 1979 and 5 more landings, probably the efforts of 2 females, took place between 14 and 24 June. Allowing for 4 landings per female in which pits were excavated deep enough to remain evident during our visit, a conservative estimate of 13 females using Desnoeufs over the first half of 1979 is obtained. Peak nesting probably takes place from May-September but laying also occurs at other times of year (Frazier 1976) and simple doubling of the estimate for the first six months gives an extremely rough estimate of an annual breeding population of 26 females. However, no recent pits were found in July 1980 and there were very few pits in the 1-6 months age class, suggesting that the

number of breeding animals can vary considerably from year to year.

Three sandy beaches lacking rock barriers or unnegotiable sand cliffs are present in June/July of which the longest is in the north (c.350 m) where the camp is situated. The remaining two are pocket beaches of 40 and 50 m length in the south east but one is steeply sloping and shingly with no evidence of nesting. However, the distribution of traces of breeding attempts does indicate that sand movements, by obliterating obstacles, allow nesting at some time or another over c.1150 m of shoreline including extensions of the three beaches mentioned above and two additional pocket beaches in the south west. Such sand movements are usually associated with the change in direction of the prevailing wind from the south-east trades to the north-west monsoon and this evidence supports the suggestion of prolonged and probable year-round breeding.

Eretmochelys imbricata

Hawksbill Turtle

A turtle seen immediately offshore in 1979 was tentatively identified as this species.

Birds

Puffinus l'herminieri

Audubon's Shearwater

A small number were regularly seen at night in the coconut grove where burrows were made by clearing natural holes in the sandstone of soil and debris. No more than 5 birds were noted on any one night in 1979 and 3 in 1980.

Puffinus pacificus

Wedge-tailed Shearwater

Several thousand pairs used the island at night in June 1979 and July 1980. Burrows were distributed around the entire perimeter of the island but were densest in the deeper sandy soils on the north east and south west coasts. Any natural or man-made break in the phosphatic sandstone further inland was also exploited and it is possible that the population approaches the maximum the island can support. Breeding is said to occur from November to February whilst June and July is a period of burrow excavation and pairing. Remarkably, the birds may be seen on the ground in the open throughout the day although numbers increase from mid-afternoon onwards.

Sula dactylatra

Masked Booby

There are two colonies on the island, one inland in the south western quadrant and a smaller colony in the dunes of the south west coast. 18 nests were found in June 1979 with a maximum count of 45 birds whilst 8 nests and a maximum of 31 birds were noted in July 1980.

On 14 June 1979 the dune colony consisted of 5 nests each with 2 eggs and the inland colony contained 9 nests, one with a clutch of

3 eggs and the remainder with 2. By 18 June the dune colony had increased by 1 nest and the inland colony by 3. A number of eggs hatched in the inland colony on 17 and 18 June by which time it consisted of 6 nests with 2 eggs, 4 with 1 egg and 1 chick, 1 with 2 eggs and 1 chick and 1 with a single chick. On 24 June 1980 the inland colony consisted of 6 nests of which 1 contained 1 egg, 2 contained 2 eggs, 1 held 1 egg and 1 chick, 1 held 2 chicks and 1 contained a single large downy chick (Van Swelm pers.comm.). On 27 July 3 nests were closely brooded and 3 contained single large downy chicks whilst the dune colony consisted of 2 nests of which one was closely brooded and the second contained a large chick.

A regurgitation was recovered from one chick, consisting of 2 semi-digested fish c.20 cm in length.

Sula leucogaster

Brown Booby

The maximum number of brown boobies recorded in 1979 was 10, whilst that in 1980 was 8 although an immature bird not included in this count was seen on several occasions. Two nests were located in 1979 of which one contained an egg. A third nest was under construction and all three were within 25 m of one another. A large downy chick was present in July 1980. Loafing brown boobies frequented the vicinity of their nests, both masked booby colonies and a rocky headland on the south coast.

Sula sula

Red footed Booby

An adult bird was noted in June 1979 and an immature in July 1980. Both birds roosted overnight in the *Hibiscus*.

Fregata spp.

Frigate birds

Immature birds passed over the island each evening in both years and although only one roosting bird was seen in 1979, up to 15 regularly spent the night in the coconuts in July 1980. The species could not generally be determined but a male Greater Frigate (*Fregata minor*) was present in June 1980 (Van Swelm pers.comm) and two Lesser Frigates (*Fregata ariel*) were seen in July.

Bubulcus ibis

Cattle Egret

Counts of roosting and foraging birds in 1979 gave a population estimate of 35 individuals and comparable numbers were present the following year. Approximately 20 disused nests were found in the *Hibiscus* in June 1979 and 21 pulli were found in June 1980 (Van Swelm pers.comm.). The birds forage over the entire island except the sea-shore and the contents of 26 pellets showed the prey to be primarily insects although 5 pellets also contained egg membranes and one included unidentified bones. Maggots have been recorded from the stomach of a Desnoeufs bird (Chong-Seng, pers.comm.) and an egret was seen taking a tern chick in July 1980. A small bounty is given for egrets because of their predatory habits and all 21 pulli were destroyed in 1980.

Pluvialis squatarola

Grey Plover

Two birds were seen in 1979 and 5 in 1980. All were in non-breeding plumage and foraged exclusively on the shore.

Arenaria interpres

Turnstone

Common, foraging on rocky shores and inland in small groups. 213 were counted in one roosting flock in 1979 and comparable numbers were present in 1980. Many birds bore bold facial patterning although none were in full breeding plumage. Turnstone preyed upon unattended sooty tern eggs and approached masked booby eggs if these were exposed after disturbance.

Calidris alba

Sanderling

One bird was noted in 1979 and two in 1980. Sanderlings freely associated with turnstone, foraging inland as well as on the shore.

Calidris ferruginea

Curlew Sandpiper

A single bird was recorded in 1980, accompanying turnstones and foraging inland.

Tringa nebularia

Greenshank

Two birds were present in July 1980, foraging on the shore.

Limosa lapponica

Bar-tailed Godwit

Two birds were noted in July 1980, foraging primarily inland but roosting with turnstones on the shore.

Numenius phaeopus

Whimbrel

A single whimbrel was seen on the beach on 27 July 1980.

Gallus gallus

Feral chicken

Frequently seen in the vicinity of the coconut grove and *Hibiscus*. Chickens were taken sparingly in 1979 but jealously guarded in 1980 although they were suspected of predating seabird eggs.

Thalasseus bergii

Crested Tern

Three subadults and one adult were present in June 1979 while 6 were noted in June 1980 (Van Swelm, pers.comm.). Eight subadults were noted on 23 July but numbers rose rapidly thereafter and 28 birds of all ages were seen at the end of the month. The Crested Terns generally foraged in the surf line but also took tern chicks. In both years juveniles were seen unsuccessfully begging from adult birds.

Sterna fuscata

Sooty Tern

The massive sooty tern colony is the most remarkable feature of Desnoeufts. Estimates of numbers were derived from egg counts along transects in the reserve and from the daily egg collection over the remainder of the island. The method is described in detail elsewhere (Wilson and Chong-Seng 1979), the only difference between years being that the counts were made in the reserve at the time of peak breeding activity in 1980 but 15 days beforehand in 1979. The 1980 estimate of peak attendance was 769,000 pairs on 11-13 July whilst that for 1979 was 1,195,000 pairs on 3 July. This latter figure relied upon a projection from counts in mid-June and assumed a maximum laying density of 5 nests/sq m throughout the *Stenotaphrum*-free part of the reserve, but, although maximum densities of 4.5 nests/sq m were reached in 1980, the average over the whole reserve was only 2.4 nests/sq m. The number reported at the close of the 1979 season was therefore probably an over-estimate and the actual figure is better taken as lying between 844,800 and 1,195,000 pairs.

The estimates are of the maximum number of breeding pairs based on the island at any one time and are not measures of the total number of pairs which used the island during the entire breeding season. Such an estimate would be complicated by inter-colony movement of breeding birds and was not attempted.

Squid and flying fish up to 12 cm body length, small shrimp-like crustaceans and siphonophores (?*Porpita* sp.) were found amongst the Sooty Tern colony and were assumed to be food items.

The Sooty Terns did not lay on the dunes where Wedge-tailed Shearwaters were common although they were present up to the beach crest on hard substrates. Numbers were generally low in areas dominated by *Stachytarpheta* and *Cyperus ligularis* and no laying took place under the coconut grove. Large numbers of eggs were lost in July 1980 when shallow pools formed after heavy rain. Once these pools dried out the open areas were swiftly recolonised.

Sterna anaethetus

Bridled Tern

Two pairs of breeding bridled terns were located in the cropped part of the island in 1980. Both had lain beneath cairns.

Anous stolidus

Common Noddy

Common noddies bred throughout the island in both years, forming small colonies in rocky areas around the perimeter of the island and, further inland, on cairns, boulder piles, heaps of herbage uprooted by the egg collectors and in coconut crowns. Noddy nests were counted at the same time as those of the sooty terns and 8400 breeding pairs were estimated in the reserve in July 1980. Assuming the same density throughout the island the breeding population is in the region of 20,000 pairs. One chick was found in mid-June 1979, suggesting laying had begin in mid-May. Eggs and chicks were present in July 1980 but

the ages of the oldest chicks indicated onset of laying at the beginning of June.

Anous tenuirostris

Lesser Noddy

Single birds roosted in the coconuts on the nights of 18 June 1979 and 22 July 1980.

Gygis alba

White Tern

Two birds were seen offshore on 24 July 1980 and a single bird flew over the island on 26 July.

Foudia madagascariensis

Madagascar Fody

A small flock frequented the coconut grove and mixed herb community behind settlement with maximum counts of 6 birds in 1979 and 16 in 1980.

Mammals

Mus sp. (?*musculus*)

House Mouse

Mice were common in the camp and consumed eggs held for shipment but their distribution over the island as a whole was not ascertained.

Oryctolagus cuniculus

Rabbit

Rabbits were released on Desnoeufs prior to 1900 (Percy and Ridley 1958) and were common in 1979/1980 ranging over the whole island although most frequently around the coconut grove from which they emerged to forage at dusk. At least 20 were taken for food in 1979 and probably more in 1980.

Tursiops spp

Dolphins

Schools of dolphins up to 75 strong were commonly sighted offshore. Bottle-nosed dolphins (*Tursiops truncatus*) were definitely present but a second species, smaller and more greyish with a proportionately more slender bill and narrow dorsal fin, was also common and may have been predominant in some groups.

Land use

Desnoeufs is government owned but given out on a single lease with Marie-Louise. It has been held by a succession of private individuals and companies and has been most recently taken over, in 1981, by the Island Development Company.

Guano

The island was first sighted in 1771 by the Du Roslan expedition

but remained uninhabited until it was permanently settled for the exploitation of guano towards the end of the 19th century (Percy and Ridley 1958). This activity ceased around 1910 although the deposits are the largest remaining in Seychelles (Baker 1963). Small shipments of several tons each are still occasionally taken to Marie-Louise for agricultural purposes.

Agriculture

In the first decade of the 20th century Marie-Louise had two lessees of which one developed the agricultural potential of the island in the wake of the guano exploitation (Wilson in prep.) and it is probable that the same system was applied to Desnoeuvs although with less success. About 30 coconuts had been planted in 1900 (Ridley and Percy 1958) and rows of pits bear evidence of considerable effort to create a coconut plantation over the entire island whilst the deep wells, substantial turtle pond and remains of paved cart-tracks probably also date from this period. About 300 pigs were free-ranged between 1900 and 1910, subsisting on herbage and eggs, and pigs have occasionally been released outside the birds-egg season since then but not as common practice (O. Souris, pers.comm.). The coconuts are not considered worth collecting but tobacco is sometimes grown over the north-west monsoon and is said to be very successful. Chickens and rabbits are primarily taken for use by Marie-Louise inhabitants but are also shipped to the granitic islands in small numbers.

Seabirds

The seasonal seabird egg collection, taking place between mid-May and early August, is the major commercial activity on the island. This operation has been described elsewhere (Percy and Ridley 1958, Feare 1976) and continues on the same lines with three recent modifications; the close season has been discontinued in favour of establishment of the 16.6 ha reserve, the crates (used as a basic measure of the annual crop) have been reduced in size to take 400 rather than 750 eggs and Department of Agriculture staff monitor the collection on the island each year. 1,037,600 eggs left Desnoeuvs in 1979 and 723,700 in 1980, both figures including ca 10% sent as gifts by the lessee or labourers and not reaching the open market but excluding the consumption on the island itself, estimated to be one crate per day.

Shearwater chicks are cropped annually during February and early March and around 2000, said to be half the total number available, are taken each year for shipment to the granitic Seychelles. It is strongly suspected that both frigates and noddies are taken for food from time to time.

Turtles

Green turtles are captured whenever the opportunity presents itself. Although some animals may have been exported from Desnoeuvs in the past all are now consumed on the island. Desnoeuvs is generally deserted during the north-west monsoon when breeding hawksbills might be expected.

Discussion

Ecology

Both Marie-Louise and Desnoeufs were described by the Du Roslan expedition in 1771 as being well-wooded and it would be remarkable if these two neighbouring islands of similar geology and comparable size were markedly different in ecology in their pristine condition, although Desnoeufs could have harboured ground-nesting seabirds on its coasts or in clearings inland. The differences today between bleak, open Desnoeufs and Marie-Louise with its overgrown coconut plantations and *Scaevola* thickets must therefore be primarily due to a difference in land-use practice. Certainly the known history of human activity on Desnoeufs and the fact that 40% of its flora is introduced, including the dominant *Stachytarpheta*, suggests profound modification despite the assertion that it is the "the only example of a virtually untouched island in the [Amirantes] group" (Piggott 1963).

It is most probable that the early management of Desnoeufs and Marie-Louise was run on identical lines. At the turn of the century birds' eggs were not an important article of commerce, as the free-ranging of pigs to feed on eggs suggests, and both islands were exploited for guano before being planted up with young coconuts. The difference between the two must have its source here, for the Marie-Louise plantation was successful whilst that on Desnoeufs was not. The likely explanation is that stripping of the vegetation to exploit the guano included, on Desnoeufs, the destruction of the coastal shelter thus allowing salt-laden wind to severely retard regeneration of woody vegetation over the entire island. The open space thus formed would favour expansion of any existing sooty tern colony, creating conditions even less suitable for regeneration and the open vegetation type would be perpetuated after the establishment of birds egg cropping by the practice of annual extensive clearance of ground cover to promote maximum nesting density in the colony. Thus the predominance of ground-nesting seabirds is itself an artifact, having replaced a largely arboreal breeding avifauna. Under any circumstances Desnoeufs stands as an example of the extreme and often unexpected alteration which can be imposed upon an island ecosystem in a relatively short time-span, in this case around a century, by human management.

The records of the natural history of Desnoeufs collected by Percy and Ridley (1958) and continued by subsequent visitors also gives indication of the turnover of species which is to be expected on the island. It is known that *Cassytha filiformis* had been lost and *Stachytarpheta* established in the early part of the 20th century. *Carica*, *Tribulus* and *Ipomoea macrantha* were all recorded in 1979 but not the following year whilst *Nicotina* made a perhaps temporary appearance and the marked increase in *Passiflora* may signify expansion of a recent coloniser. Among the birds, Green-backed Heron (*Butorides striatus*) and Lesser Noddy bred in 1955 (Percy and Ridley 1958) but not 1979/80 although the Lesser Noddy still roosts. Crab Plover (*Dromas ardeola*), Great Sand Plover (*Charadrius leschenaultii*) and Mascarene Martin (*Phedina borbonica*) may also be added to the bird list as migrants or vagrants.

Percy and Ridley (1958) remarked upon the crickets in their tent yet made no mention of mice; any comment now on nocturnal nuisances would not make this omission, suggesting the mice too are recent colonists as may be the second gecko species. A continual flux in species composition of the island biota is evident.

Conservation

The conservation value of Desnoeufts lies entirely in its seabirds. The Sooty Tern colony is one of the largest in the world whilst, although their breeding populations are not the most substantial in the Seychelles, the boobies are of note in view of their general decline in the region (Feare 1978). Most importantly, the management of Desnoeufts is directed towards maintenance of its wildlife for economic gain in a durable system coordinating commerce and conservation and, whatever feelings one may hold regarding the trade in birds' eggs, there is no doubt that the disparate interests marshalled behind maintaining the productivity of the Sooty Tern colony act in the general favour of wildlife conservation both on Desnoeufts and, by example and association, elsewhere in Seychelles.

The main means by which conservation is effected is through the establishment of the 16.6 ha reserve in partial response to the most recent recommendations on the management of the egg collection (Feare 1976). The breeding seabirds in the reserve, which include the boobies, remain totally unmolested whilst all eggs laid in the remaining 23.1 ha of the island are taken for as long as it is profitable to do so and at least two Ministry of Agriculture staff are present on the island throughout the collection to ensure the reserve is not violated, to monitor the egg crop and to gather the information from which annual breeding populations may be calculated.

By and large this system works well and the reserve is respected, for although the two wardens may have difficulty in asserting authority when living in isolation with up to 30 egg collectors, the purpose of the reserve in maintaining egg production is generally understood. Potential for problems arise more where the need for control is less well appreciated and the degree of protection which can be afforded to female green turtles and to noddy terns is limited, particularly when the condition of the landing prevents fishing to vary the egg dominated diet of the island workers. However, with noddies at least it is highly unlikely that the limited depredations which take place have an appreciable effect on overall numbers.

These shortcomings apart, the conservation management of the island during the cropping season is fair given the circumstances under which it operates and its essential feature is that it works. The Sooty Tern population has been consistently estimated at between 1.2 and 1.75 million pairs over the past 25 years (Feare 1976, Percy and Ridley 1958, 1966, Procter 1970) with peak laying in June. The 1979 and 1980 seasons were both late and poorly attended, regular occurrences which, taken in conjunction with possible differences in counting technique between observers, do not allow the low census results of

these latter years to be taken as evidence of overcropping.

The landing beach is unusable from late August until the north west monsoon has set in and over this period the island provides totally safe conditions for boobies to rear chicks and for turtles to breed. From mid-October to late May however, the island is unwardened and accessible to boats fishing in the area or from Marie-Louise. Given the traffic in the Amirantes it is quite possible that such visits are frequent although individually of short duration and, in the absence of permanent occupation, the beaches should still provide relatively safe breeding for the small number of turtles that frequent them, thus assisting in maintaining the eagerly sought-after turtle population among the islands. The boobies are more at risk. In 1955 Desnoeufs supported some 20 Brown Boobies and, between 1955 and 1965, 100-450 pairs of Masked Booby, yet by 1974 only 4 Brown and 21 Masked Booby pairs bred, reduced further in 1976 to 3 Brown and 17 Masked Booby nests (Feare 1978). The observations presented here suggest that the rate of decline, attributed to human predation, is slowing but reports of destruction of boobies continue with both visits by fishermen and oil pollution being blamed. Permanent wardening is not feasible and control over such activity impossible to exert unless there is a fundamental change in attitude towards these birds. Until such time as this might be effected, the only boobies likely to be reared successfully on Desnoeufs are those hatched and fledged between May and October, making the recovery of the island population unlikely.

Of other species, the Wedge-tailed Shearwater population appears to be maintaining its numbers and descriptions by Percy and Ridley for 1955 and 1966 apply equally well today despite their recommendation to increase cropping (Percy and Ridley 1966). The Cattle Egrets also seem capable of withstanding the intense persecution recommended by Percy and Ridley and carried out by successive island managers.

The pattern of human activity on Desnoeufs is now well established in a generally satisfactory manner and, whilst further refinement of both wildlife conservation and of the birds' egg trade is desirable and expected, the future management of the island is likely to continue on the same lines as long as care is taken not to increase the crop beyond the sustainable yield of the tern population and that the commerce is maintained.

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