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GEOMORPHOLOGY AND VEGETATION OF ILES GLORIEUSES

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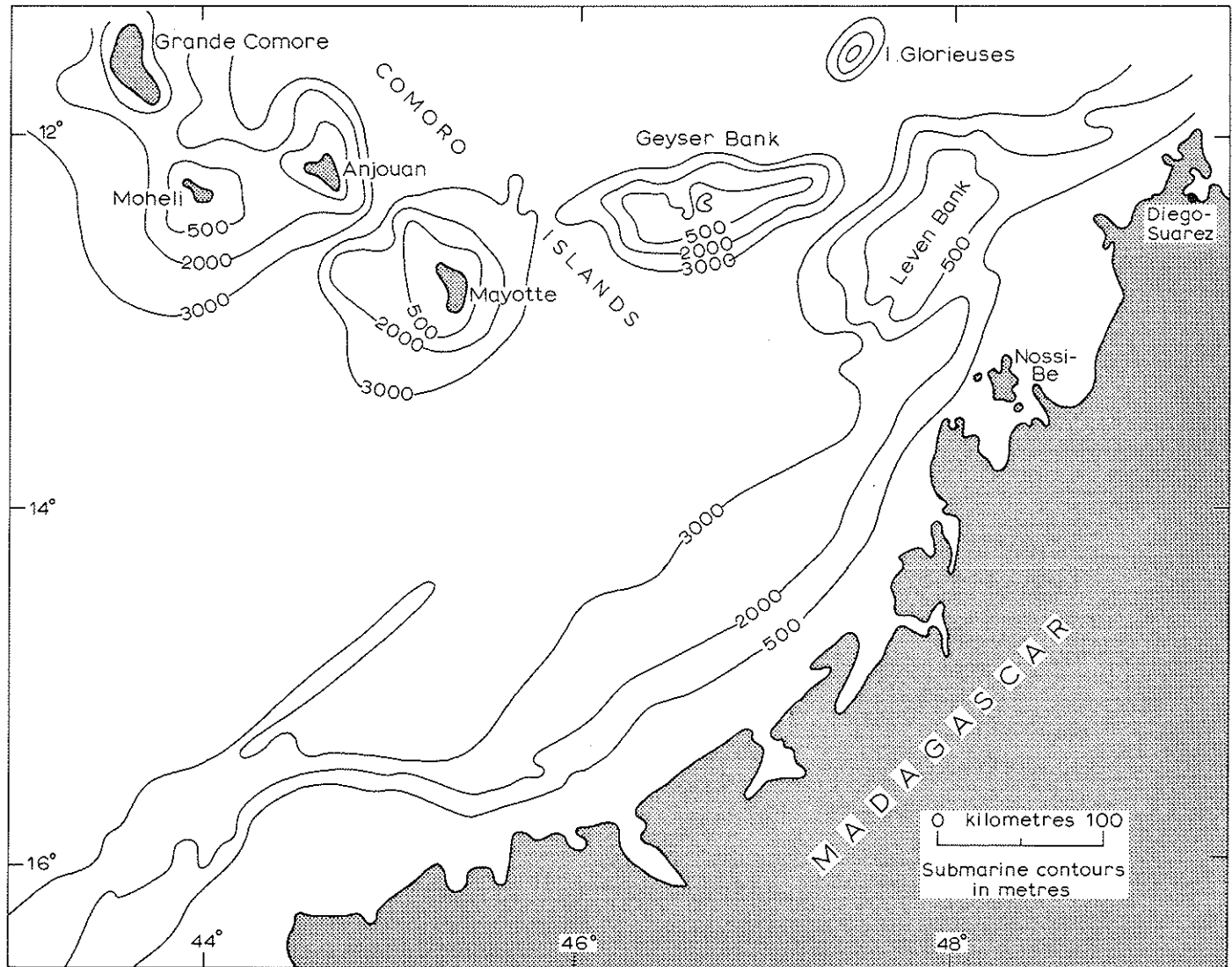


Figure 1. Location of Iles Glorieuses

GEOMORPHOLOGY AND VEGETATION OF ILES GLORIEUSES

by R. Battistini¹ and G. Cremers²

INTRODUCTION

The present study was carried out with the assistance of the O.R.S.T.O.M. oceanographic vessel *Vauban*, a 24.5 m trawler. The field party, which spent the three days 28, 29 and 30 January 1971, on the islands, consisted of R. Battistini, geomorphologist, of the Université de Madagascar, G. Cremers, botanist, of O.R.S.T.O.M., and A. Crosnier, director of the Centre O.R.S.T.O.M. at Nossi-Bé.

The Iles Glorieuses are situated north of the Mozambique Channel, at 11°30'S latitude and 47°20'E longitude. The group consists of two islands, Grande Glorieuse and Ile du Lys, located on a large coral platform 17 m long and aligned southwest-northeast. The outer slopes of the platform are extremely steep (between 20° and 35° on the south and southeast sides between 75 and 1500 m depth), suggesting that the coral has a volcanic basement. No volcanic rocks outcrop, however, and the depth of the basement beneath the coral is not known.

There is a meteorological station on Grande Glorieuse, maintained by the Service Météorologique de La Réunion, which has operated for about ten years. The mean annual rainfall is 1012 mm, and the mean monthly figures are as follows:

<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
206.3	152.9	151.7	95.7	83.7	67.9	38.5	59.7	11.4	5.1	20.1	119.0

The prevailing winds are the Southeast Trades, with 42.3% of the observations in the sectors ENE, E and ESE, except for January and February when the dominant winds are W, WNW and NW (37.9% in January, 38.8% in February).

ACKNOWLEDGEMENTS

We thank the Centre Océanographique of O.R.S.T.O.M. at Nossi-Bé, and especially its Director, M. Alain Crosnier, for the welcome and assistance given to us during this expedition. We thank also Commandant Fiuric of the *Vauban* and his crew. M. Poonoosawny, in charge of the meteorological station, and his three colleagues also assisted in this work, and we are glad to thank them here. We thank the Service Météorologique de La Réunion, and particularly M. Malick, for the climatic statistics. Cremers also thanks Dr. J.-L. Guillaumet and A. Rakotozafy for their valuable aid.

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GEOMORPHOLOGY OF THE ILES GLORIEUSES

by R. Battistini

Grande Glorieuse

Grande Glorieuse, at the southwest end of the reef, is oval-shaped, with a maximum length of 2300 m and width of 1700 m. It is a low sandy island, formed during the Flandrian by the accretion of a large number of parallel beach-ridges. The beach-ridge morphology is obscured in the east and northeast by dune-formation: on this side of the island there is a large dune field, reaching a height of 12 m, covered and fixed by a dense vegetation of *Casuarina* and other species. The northeast and east coasts are the only ones to have a narrow zone of active dunes, with nebkas and small parabolic dunes, formed by the dominant easterly winds.

On the south and southeast coasts the beach crest is a sandy storm ridge, completely covered with a shrubby vegetation of *Scaevola* and *Cordia*, and without dunes. Water from storm waves covers the vegetation and reaches up to 10 m inland from the beach crest. The west coast, formed by lower flatter beach ridges, also lacks dunes. The centre and western part of the island is occupied by a large but now abandoned coconut plantation.

In the south and southwest the Flandrian sand deposits abut against the karst-eroded remains of an older reef structure which we correlate with the Karimbolian high stand of the sea (probably about 125,000 yr B.P.); these remnants are named Ile aux Crabes, Rocher Champignon, and Rochers du Cap Vert. They consist of banks of limestone with *Tridacna* and with large coral heads in the position of growth, covered at Ile aux Crabes with shelly limestones with rolled coral debris, reaching up to about 3 m above the level of present highest tides. The limestones are deeply dissected into large lapiés, with tidal notches and overhanging visors overlooking a low-tide platform, smooth or with enclosed pools, in the same old limestones.

These limestone remnants include in their upper parts inclusions, brown to black in colour, some of several cubic metres in size, which appear to have formed in old solution holes and are now consolidated. The upper surfaces of the inclusions are eroded like the rest of the limestones. Bone fragments and pieces of carapace of an unidentified tortoise have been obtained with difficulty from these inclusions. Similar inclusions, but without bones, have been described at Europa (Battistini, 1965, 1966; Berthois and Battistini, 1969).

The coast zonation in the west and south is as follows:

- (1) the beach, which is always sandy.
- (2) beachrock, of which there are only three outcrops, two on each side of Ile aux Crabes, and one to the southeast of Cap Vert.
- (3) a platform of reef limestone, 300-500 m wide, which dries almost completely at low water; as at Europa, this is probably largely an eroded pre-Flandrian structure.
- (4) a rubble zone of small boulders.

Beyond the rubble zone, the grooved outer slope had little living coral at the two places where it was observed. In shallower water it is covered with banks of *Halimeda* sand, with, in deeper water, isolated coral heads, which are more numerous between 15 and 35 m depth.

Ile du Lys

Ile du Lys, about 600 m long, is much smaller than Grande Glorieuse. It is almost entirely formed of reef limestones with *Tridacna* and coral heads in the position of growth and by stratified beds of reef debris of pre-Flandrian age. On the north side, exposed to the heavy swell, the limestones are eroded along their whole length into lapiés, in places with overhangs 4-6 m high. The northwest point is a karst-eroded plateau 3-5 m above the level of present highest tides, scattered with large coral heads in the position of growth. The old coral limestone is here covered by stratified deposits, dominated by *Halimeda* debris; some of these deposits seem old, but others are recent, and are probably storm deposits cemented to form beachrock, since they contain copper nails from a wreck.

The coast zonation on the north side is as follows:

- (1) storm beach overlying the coral limestone.
- (2) high-tide platform with lapiés and pools with undercut edges.
- (3) cliff with large pinnacles, with or without visor, 4-6 m high, cut in old coral limestone.
- (4) low-tide platform, with large smooth grooves perpendicular to the shore, cut in the same old limestone.
- (5) shallow channel with some patches of *Halimeda* sand and marine grasses.
- (6) rocky outer rim, 0.5-1 m in height, consisting of old coral limestone with superficial incrustation by recent calcareous algae.
- (7) outer slope, with some large living coral heads.

Bedded detrital limestones, with dips of up to 15°, formed of coral and shell debris, outcrop on the east and west sides of the island. These deposits overlie the massive coral limestones of the north, but, with the exception of some outcrops near the leeward point which are probably Flandrian beachrocks, they are placed in the same period (Karimbolian).

In the centre of the island there is a shallow pool, with outflow to the north, with a vegetation of *Pemphis acidula*. The pool is tidal, and is reached by storm waves across the shrub-covered storm ridge on its northern side.

The whole of the leeward or southern part of the island consists of guano mixed with beds of *Halimeda* sand, of a yellow to light brown colour, with a vegetation of *Tournefortia*. This area includes the highest point on the island (11 m). A sand spit is forming towards the south on this leeward side, and is colonised by a few patches of grass.

The island is inhabited by thousands of rats, which probably arrived either on the wrecked ship the remains of which are visible near the pool outflow in the north, or during a recent attempt at settlement from which a cistern and some other articles remain. There is now only a small colony of terns, preserved from the rats on mushroom rocks of *Halimeda* limestone at the western end of the island.

The Reef flat and Roches Vertes

The upper surface of the reef was traversed with an outboard to the south of Ile du Lys and between Grande Glorieuse and Roches Vertes. It is almost entirely sandy, with higher sandy banks drying at low water.

The Roches Vertes form a group of four rocks entirely constituted of the same reef limestone, with large coral heads in the position of growth, that outcrops at Ile du Lys and in the south of Grande Glorieuse, of Karimbolian age. Their upper surface, with small-scale karst erosion, carries a skeletal soil with a low halophytic vegetation of *Sesuvium portu-lacastrum*, at least on the two southwest Roches. A very large colony of terns survives here.

The coral limestone has inclusions of brown and black material, with bone fragments, identical to that described on Grande Glorieuse and also found in the northeast of Ile du Lys, which we interpret as the lithified fill of ancient solution holes. The Roches are dissected into large lapies and mushroom rocks, standing on a low-tide platform of the same old coral limestone.

CONTRIBUTION TO BOTANICAL KNOWLEDGE OF ILES GLORIEUSES

by G. Cremers

Formation and evolution of the islands

The Iles Glorieuses are formed of coral and algal sand, with outcrops of coral limestone on the west coast of Ile du Lys, at Cap Vert on the southwest coast of Glorieuses, at the small Ile aux Crabes to the south of the main island, and forming the Roches Vertes. The process of development of the islands is most apparent on Glorieuse, which covers 4 sq km.

In the field we observed zones of parallel dunes, especially in the southern part of the island. Air photographs taken by the French Army based at Diego Suarez have confirmed that this is an area of progradation. Conversely in the north-north-west is a zone of erosion. The general tendency is towards an increase in the surface area of the island.

This evolution has resulted in a zonation of vegetation as well as of relief. From the periphery towards the centre the main zones are:

- (1) the beach,
- (2) the zone of dunes, well-marked on the south and east coasts but eroded away in the north,
- (3) a shallow depression on the landward side of the dunes, swept by waves overtopping the dunes during periods of high tides and cyclones,
- (4) the central zone, covering the main part of the island. This has a dense vegetation of shrubs and small trees, with a few taller trees. It is probable that the whole central area was once covered by this vegetation, which is now confined to the east and south. The west of the island is occupied by a coconut plantation, now abandoned and more or less invaded by other species. Between the plantation and the natural woodland there is a zone of degraded vegetation. Finally the existence of the airstrip has favored the establishment of numerous herbs not found elsewhere.

Botanical history of the islands

The first botanical report on the Iles Glorieuses which has been found is that of Coppinger (1882). He found "a dense vegetation of primary forest" on Grande Glorieuse, and on Ile du Lys a wooded region with *Ficus*, *Hibiscus* and *Scaevola*, and with *Pemphis* in the mangrove.

The islands have been officially administered by France since 23 August 1892, although a French colonist, M. Caltaux, had already lived there for ten years.

Abbott (1893) found 30 species of plants on Grande Glorieuse, and trees 15-20 m high in the mangroves on du Lys. The vegetation has clearly been much altered and impoverished since this time. Nicoll (1908) also visited the islands. According to the report of Captain Lebegue on 16 November 1921, the plantation on Grande Glorieuse consisted of 6000 coconut palms, with a population of 17 Seychellois. The settlement was in the northwest part of the island. The vegetation, apart from the plantation, some maize, and *Casuarina*, was a stunted scrub. The Ile du Lys was uninhabited, but there were numerous traces of attempts at exploiting the guano. A herd of about 200 goats was on this island.

While it was thought that the islands were uninhabited, the visit of the lightship *Marius Moutet* in February 1954 revealed that a colonist from the Seychelles had lived there for about a dozen years and the plantation had increased to about 15,000 trees.

At the time of our visit in 1971, there were four men from Réunion, members of the Service Météorologique de la Réunion living on Grande Glorieuse. The herd of goats had disappeared from Ile du Lys, but had been replaced by a larger number of rats.

Vegetation

Grande Glorieuse:

On this island of 4 sq km, 43 species of plants have been found, some of them brought by man. These include *Cocos nucifera*, but also *Carica papaya*, *Flacourtia ramontchii* (the fruits of which are eaten), *Ricinus communis*, and perhaps *Catharanthus* sp.

(1) Dune belt (Plate 13):

As already pointed out, there is a well developed zone of dunes in the south of the island, but they have been eroded away in the north. The vegetation consists of a woodland 4-5 m high at the top of the dunes, the width varying with the terrain. This woodland consists essentially of three species of small trees. One with orange flowers, particularly abundant, is *Cordia subcordata*. The others are *Scaevola taccada* and *Guettarda speciosa*. On these trees is a lichen of the genus *Rocella* and the parasitic vine *Cassytha filiformis*. The trees are all heliophiles, with leaves at the ends of branches, forming a canopy with an understorey of *Achyranthes aspera*. *Suriana maritima* is another shrub scattered through the trees. In the open areas there are several creeping herbs, such as *Launea sarmentosa*, *Sida ovata*, *Boerhavia repens*, and a sterile grass which has not been determined but which may be *Tricholaena monachme* (no. 1356).

(2) Depression inland from the dunes (plate 13):

In this depression, submerged during high tides, one finds almost exclusively the sedge *Fimbristylis abbreviata*. The young plant forms a tuft, which increases in diameter as the plant grows; the inner parts die so that the living parts of mature plants form rings (Plates 14 and 15). One finds also certain species from the dune belt, such as *Achyranthes aspera*, which is much more stunted than in the shade, an unidentified grass (no. 1356), another (no. 1394) which may be *Dactyloctenium aegyptium*, and also *Portulaca oleracea* which is not found in the interior of the island.

(3) Centre of the island:

It is the area south of the airstrip which we have attempted to study in greatest detail, in spite of the difficulties of penetrating the vegetation of small trees and shrubs. The area to the north has been much influenced by man, with the coconut plantation, the old and the new meteorological stations, the trial airstrip, and the present airstrip at an angle to the first.

(a) Natural vegetation (Plate 16):

This consists of a dense woodland 2-4 m high. The most numerous tree is *Tournefortia argentea*, forming small dome-shaped strongly-branched trees which were found in all stages of flowering and fruiting. The other species is *Scaevola taccada*, each plant covering a smaller area than one of *Tournefortia*. This species was fruiting, although it was in flower on the dunes. Parasitic *Cassytha filiformis* is very common on these trees. Several large isolated trees dominate the area: *Cordia subcordata* and *Guettarda speciosa* (fruiting). The herbaceous stratum is almost non-existent, except in open areas, where we find the sterile grass (no. 1356) and *Fimbristylis abbreviata*.

(b) Degraded vegetation:

Along the airstrip, apart from two trees, *Flueggea microcarpa* and *Colubrina asiatica*, one finds mainly prostrate herbs of which the seeds have probably been brought by aircraft. They include *Sida rhombifolia*, two species of *Phyllanthus* (nos. 1368 and 1369), one species of *Cyperus* (no. 1383), and *Portulaca oleracea*.

In the coconut plantation, *Casuarina equisetifolia*, which was planted along the shore as a windbreak, has multiplied greatly since the plantation was abandoned and is now found throughout. The same is true of the very abundant *Ficus* sp. (no. 1410). Several other species are widely distributed, such as *Flueggea microcarpa*, *Colubrina asiatica*, and tufts of *Cyperus* sp. (no. 1383). At the edge of the plantation is a big *Terminalia catappa*, with *Stachytarpheta jamaicensis* and *Ipomoea* sp. (no. 1390) beneath. Several *Flacourtia ramontchii* have been planted along the paths.

In the north of the island, other species are growing at the site of the former meteorological station and at the cemetery. Human influence is clear in the importation of *Carica papaya*, *Ricinus communis*, *Gossypium brevilanatum*, and probably also of *Acalypha* sp. (no. 1374), *Adenia* sp. (no. 1385), *Caesalpinia bonduc*, *Catharanthus* sp. (no. 1375), and *Ipomoea* sp. (no. 1379).

(c) Pool:

There is a small tidal pool in the northwest part of the island, which dries completely at low water. Round its margins grow the shrub *Suriana maritima*, herbs, *Sporobolus virginicus*, and an undetermined sterile grass which may be *Tricholaena monachme* (no. 1378).

(d) Beach:

Several different species are found on the shore in the north of the island. These are *Sporobolus* aff. *virginicus*, *Ipomoea pes-caprae*, *Tribulus cistoides*, and *Wedelia biflora*.

Ile du Lys:

This much smaller island, a few hundred meters long, is poor in species, with a total of only 8. Overtopping by waves during very high tides may be the reason for this poverty.

One can see no zonation in the little vegetation which now exists on the island. Trees of *Tournefortia argentea*, characterized by their dome-shaped appearance, are found almost everywhere round the periphery of the island. In the higher southern part, however, they are much bigger, reaching a height of 5 m and crown diameters of 10-12 m (plate 17). The small trees growing amongst them are *Thespesia populnea*, also in full flower. Behind these trees one finds several trees of *Ficus* sp. (no. 1403), completely leafless at this time, though on some buds have started to develop. This *Ficus* is close to no. 1410 of Grande Glorieuse and is not the *Ficus marmorata* found at Europa I. (Bossert, 1952).

In the east there are large clumps of *Sclerodactylon macrostachyum*. In the west a sterile sedge (no. 1406), which could not be determined, grows in crevices in the coral rock. In the northwest there is a pool open to the sea: around it and within it there are very numerous shrubs or small trees of *Pemphis acidula* (photo 19).

The centre of the island is formed by a large flat plain. There are two clumps of coconuts, comprising five plants in total. All around, plants of a *Boerhavia* species (no. 1408), although completely desiccated, form the first stages of vegetation (plate 18).

Roches Vertes

The Roches Vertes are always emerged, though constantly swept by waves and spray. A patch of *Sesuvium portulacastrum* has been found.

Flora

The plant specimens collected during the expedition are deposited in the Herbarium, Laboratoire de Botanique, Centre O.R.S.T.O.M., Tananarive, Madagascar, and some have been sent to the Herbarium, Muséum National d'Histoire Naturelle, Paris.

Grande Glorieuse

<i>Acalypha</i> sp.	Euphorbiaceae
<i>Achyranthes aspera</i> L.	Amaranthaceae
<i>Adenia</i> sp.	Passifloraceae
<i>Boerhavia</i> sp.	Nyctaginaceae
<i>Boerhavia repens</i> L.	Nyctaginaceae
<i>Caesalpinia bonduc</i> (L.) Roxb.	Caesalpinaceae
<i>Carica papaya</i> L.	Caricaceae
<i>Casuarina equisetifolia</i> L.	Casuarinaceae
<i>Cassytha filiformis</i> L.	Lauraceae
<i>Catharanthus</i> sp.	Apocynaceae
<i>Cocos nucifera</i> L.	Palmae
<i>Colubrina asiatica</i> (L.) Brongn.	Rhamnaceae
<i>Cordia subcordata</i> Lam.	Boraginaceae
<i>Cyperus</i> sp.	Cyperaceae
<i>Dactyloctenium aegyptium</i> (L.) Willd. (?)	Gramineae
<i>Ficus</i> sp.	Moraceae
<i>Fimbristylis abbreviata</i> Boeck.	Cyperaceae
<i>Flacourtia ramontchii</i> L'Hérit.	Flacourtiaceae
<i>Flueggea microcarpa</i> Bl.	Euphorbiaceae
<i>Gossypium brevilanatum</i> Hochr.	Malvaceae
<i>Guettarda speciosa</i> L.	Rubiaceae
<i>Ipomoea pes-caprae</i> (L.) R. Br.	Convolvulaceae
<i>Ipomoea</i> sp.	Convolvulaceae
<i>Launaea sarmentosa</i> (Willd.) Kuntze	Compositae
<i>Phyllanthus</i> sp.	Euphorbiaceae
<i>Phyllanthus</i> sp.	Euphorbiaceae
<i>Portulaca oleracea</i> L.	Portulacaceae
<i>Ricinus communis</i> L.	Euphorbiaceae
<i>Rocella</i> sp.	Lichenes
<i>Scaevola taccada</i> (Gaertn.) Roxb.	Goodeniaceae
<i>Sida ovata</i> Forsk.	Malvaceae
<i>Sida rhombifolia</i> L.	Malvaceae
<i>Sporobolus virginicus</i> Kunth	Gramineae
<i>Sporobolus</i> aff. <i>virginicus</i> Kunth	Gramineae
<i>Stachytarpheta jamaicensis</i> (L.) Vahl	Verbenaceae
<i>Suriana maritima</i> L.	Simaroubaceae
<i>Terminalia catappa</i> L.	Combretaceae
<i>Thespesia populnea</i> (L.) Sol. ex Correa	Malvaceae
<i>Tournefortia argentea</i> L. f.	Boraginaceae
<i>Tribulus cistoides</i> L.	Zygophyllaceae
<i>Tricholaena monachme</i> Stapf. & Hubb. (?)	Gramineae
<i>Wedelia biflora</i> (L.) DC.	Compositae

Ile du Lys

<i>Boerhavia</i> sp.	Nyctaginaceae
<i>Cocos nucifera</i> L.	Palmae
Cyperaceae indet.	
<i>Ficus</i> sp.	Moraceae
<i>Pemphis acidula</i> Forst.	Lythraceae
<i>Sclerodactylon macrostachyum</i> (Berth.) A. Cam.	Gramineae
<i>Thespesia populnea</i> (L.) Sol. ex Correa	Malvaceae
<i>Tournefortia argentea</i> L. f.	Boraginaceae

Roches Vertes

<i>Sesuvium portulacastrum</i> (L.) L.	Aizoaceae
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From this list it is apparent that the species found on Ile du Lys and Roches Vertes are not found on Grande Glorieuse, in spite of the small distance between them, and this can be explained by the edaphic differences between the islands. The species found only on Ile du Lys are *Pemphis acidula*, *Sclerodactylon macrostachyum*, *Ficus* sp., a species of sedge, and *Boerhavia* sp. *Sesuvium portulacastrum* is only found on Roches Vertes.

Two species are not found in Madagascar. Some are pan-tropical and are found everywhere, others are cultivated; in fact these last have a very well-marked distribution and are most numerous on the west coast. However *Launea sarmentosa*, *Scaevola taccada*, *Tournefortia argentea* are only found on the east coast. *Sporobolus* aff. *virginicus* is very similar to the form on the east coast. One species is a Malagasy endemic, *Gossypium brevianatum*, and has clearly been brought by man.

The two species not known in Madagascar are *Wedelia biflora* and *Sida ovata*. The first is found on the shores of the Indian Ocean, in the Comoros and at Juan de Nova I. The second has been collected at Tromelin I. by Paulian in 1953 (unnumbered specimen). According to Hutchinson and Dalziel (1954) this species is distributed in Africa with extensions to Arabia and India.

Three species (*Colubrina asiatica*, *Fimbristylis abbreviata*, *Launea sarmentosa*) are not recorded from Europa or Juan de Nova. No comparison has been made with the islands to the north of Iles Glorieuses.

Certain species recorded by Hemsley (1919) have not been found during the present investigation. These are:

- Apodytes mauritiana* Planch. (Icacinaceae) = *A. dimidiata* E. Mey. Distribution: East Africa, Mascarenes, Comoros, Madagascar, Cosmoledo, Astove, Aldabra.
- Boerhavia diffusa* (Nyctaginaceae). Pantropical.
- Cleome strigosa* Oliv. (Capparidaceae). East Africa, Madagascar, Aldabra, Astove.
- Cucumis trigonus* Roxb. (Cucurbitaceae). East Indies.
- Cyperus rotundus* (Cyperaceae). Pantropical and subtropical.
- Eragrostis tenella* (Gramineae). The name of the author was not given by Hemsley, and it is hence not possible to define this species, which may be related to:
- E. tenella* Benth. = *E. interrupta* Beauv. Africa, Asia, tropical Australia;
- E. tenella* Nees = *E. pilosa* Beauv. Tropical regions;
- E. tenella* Roem. et Schult. = *E. plumosa* Link. Tropical Asia and Africa; but is more likely:
- E. tenella* (L.) Beauv = *E. amabilis* (L.) W. & A.

- Euphorbia prostrata* Ait. (Euphorbiaceae). Pantropical.
Ficus aldabrensis Baker (Moraceae). Aldabra, Assumption, Cosmoledo, Astove. = *F. reflexa* Thunb.
Ficus nautarum Baker (Moraceae). Seychelles, Aldabra, Assumption, Cosmoledo, Astove, St Pierre.
Hibiscus hornei Baker (Malvaceae) = *H. physaloides* Guill. et Perr. Tropical and subtropical Africa, Comoros, Madagascar; probably introduced.
Ipomoea glaberrima Boj. ex Hook. (Convolvulaceae) = *I. macrantha* R.&S. Tropical coasts and islands.
Plumbago aphylla Boj. (Plumbaginaceae). Aldabra, Assumption, Cosmoledo, Astove, Madagascar.
Portulaca quadrifida L. (Portulacaceae). Tropical coasts and islands.
Sida spinosa L. (Malvaceae). Pantropical.
Solanum nodiflorum Jacq. (Solanaceae) = *S. nigrum* L. Pantropical.

Some of our undetermined species may correspond with some of those in this list.

Conclusion

It is clear from the reports of early visitors that the vegetation of the islands has been transformed. It appears that the vegetation was formerly quite dense: primary forest in 1882; trees 15-20 m tall in the mangrove of Ile du Lys in 1893. In 1921 a coconut plantation replaced part of the forest and only shrubby vegetation remained on Grande Glorieuse. On Ile du Lys there is no longer any trace of big trees in the mangrove.

If the number of species present has increased, from 30 in 1893 to 48 in 1971, the influence of man is the main reason. Some herbaceous species have been introduced by aircraft following the construction of the airstrip.

As Capuron (1966) has suggested for Europa I., since these islands have no economic value, it would seem useful to protect their fauna and flora in order to be able to study their natural development.

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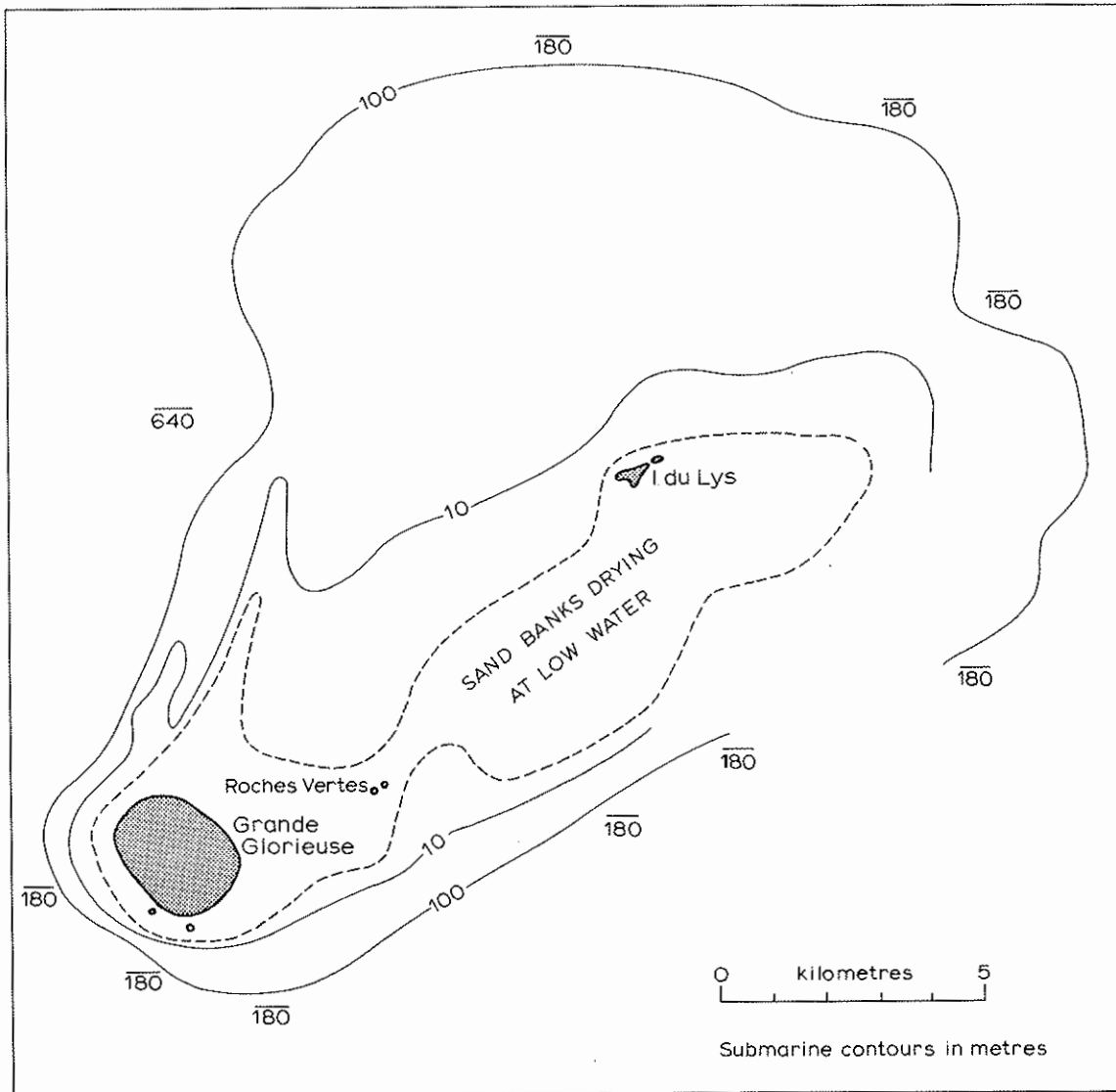


Figure 2. Iles Glorieuses, in part after hydrographic chart

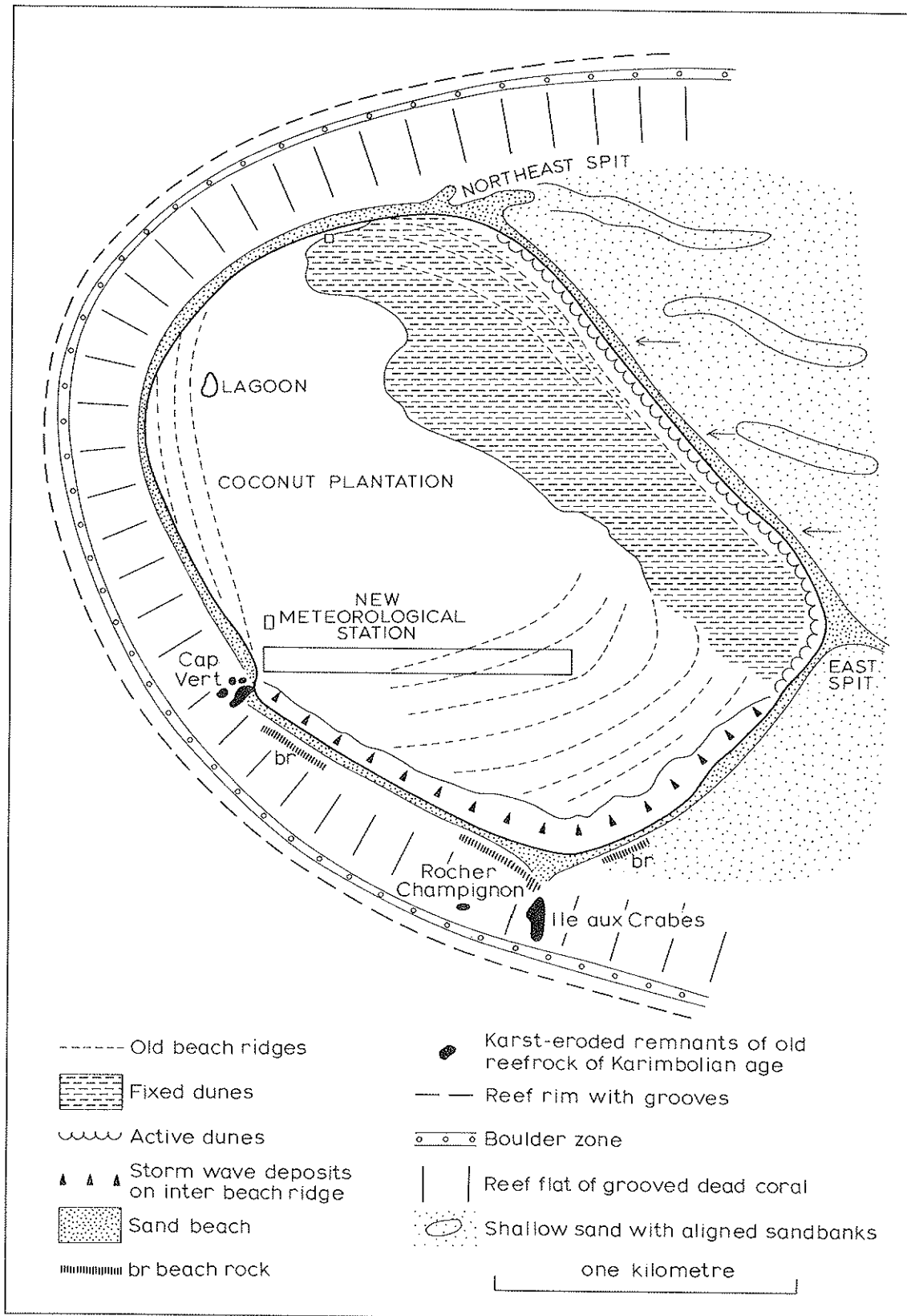


Figure 3. Geomorphic sketch-map of Grande Glorieuse

Figure 4. Section in the southern part of Ile aux Crabes

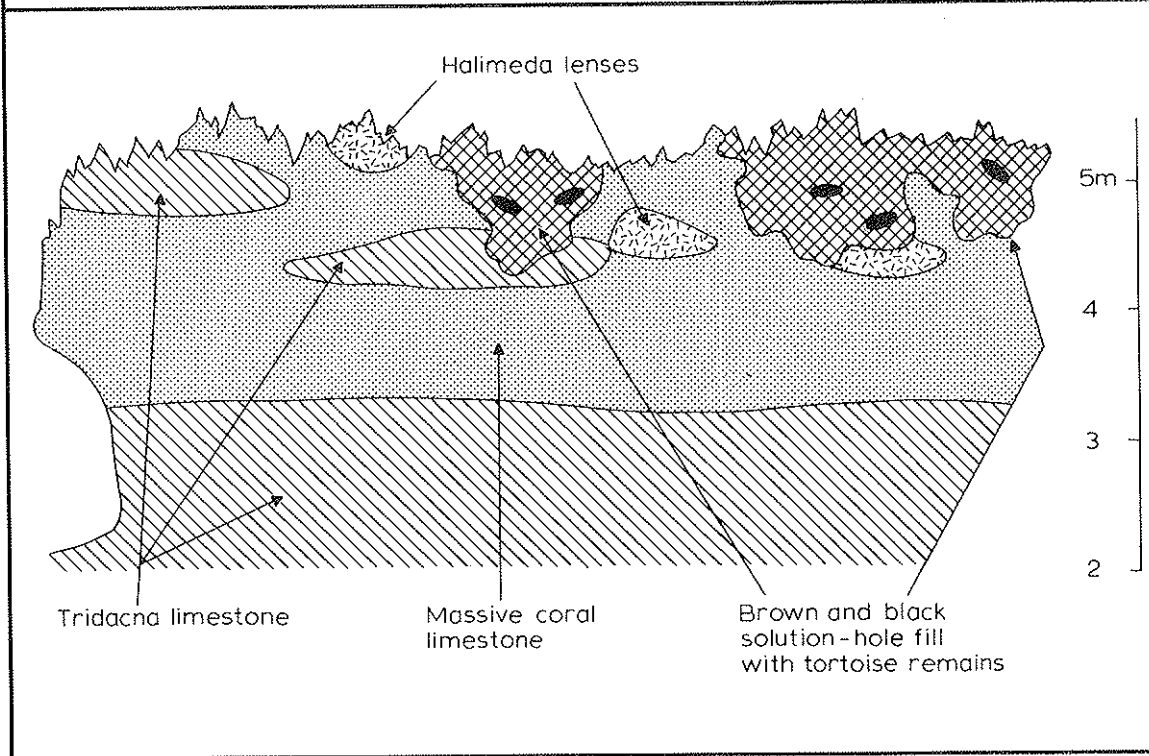
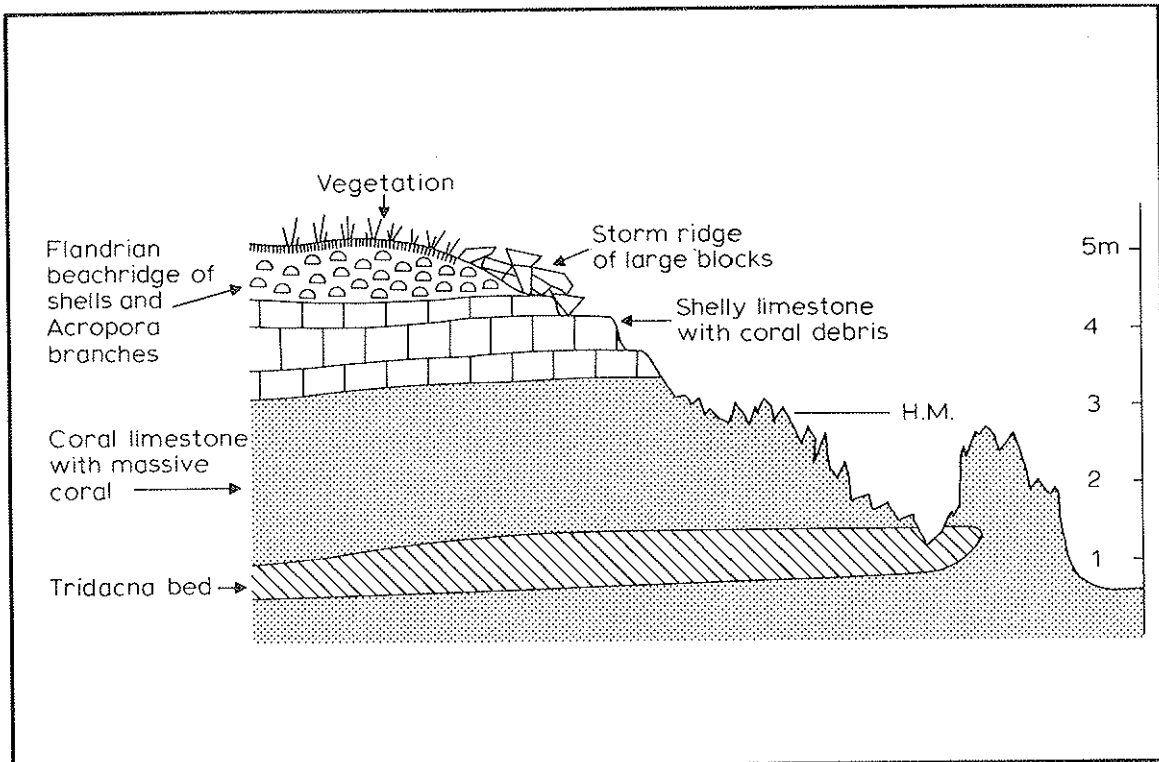


Figure 5. Section in the reef-limestone outcrop of Cap Vert

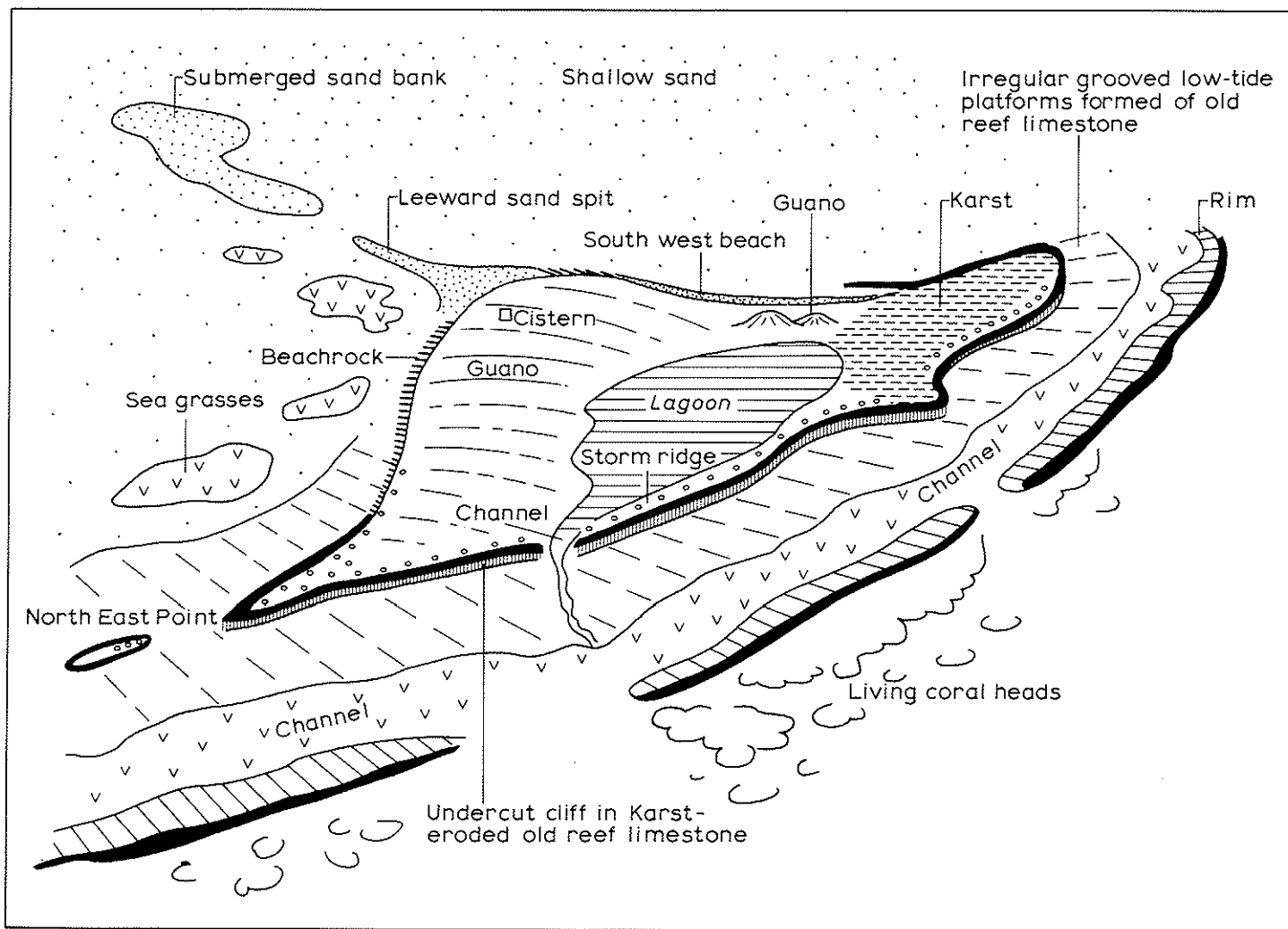


Figure 6. Geomorphic sketch of Ile du Lys (oblique view from an aerial photograph from the NNE taken by R. Battistini)

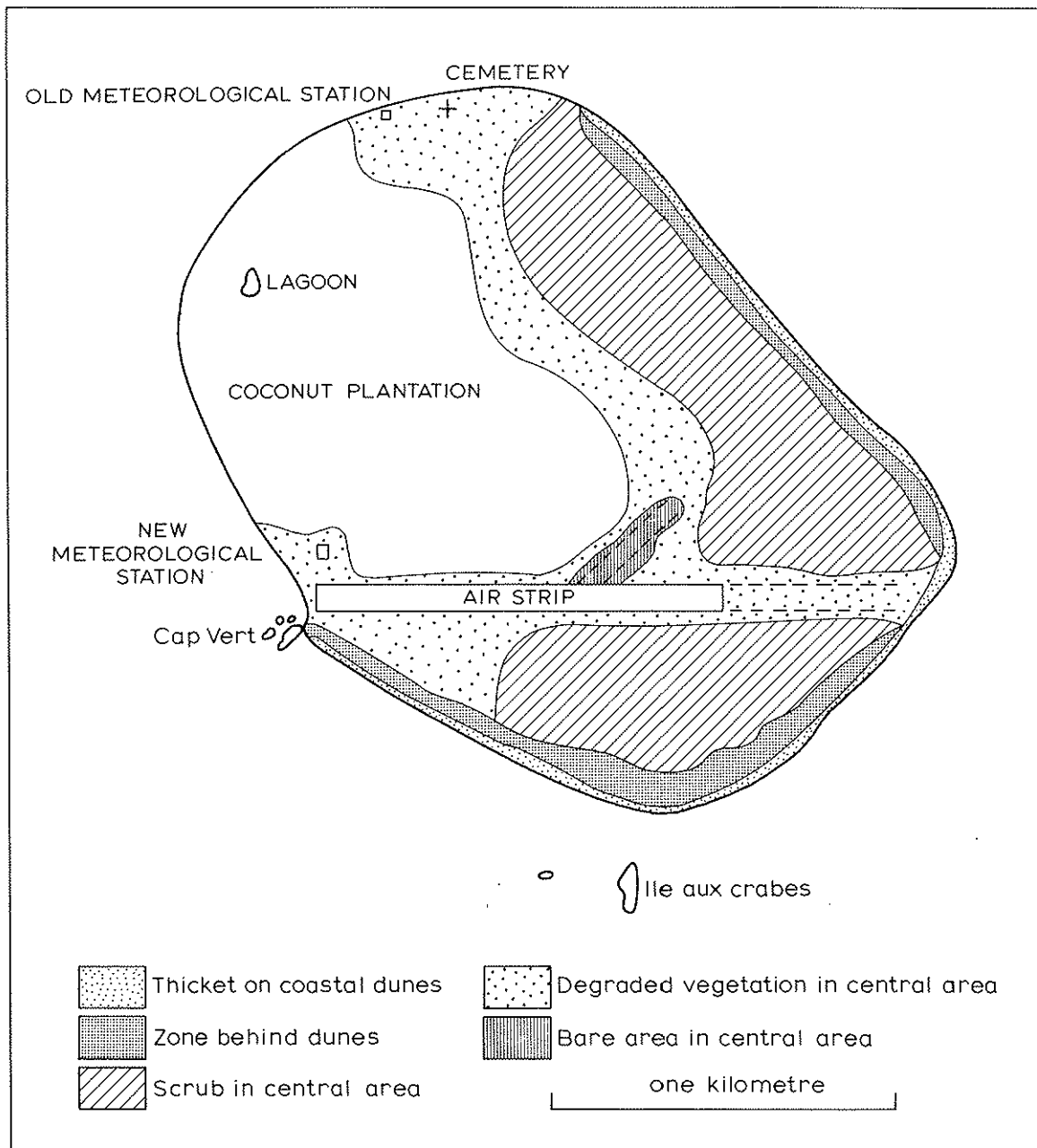


Figure 7. Sketch-map showing vegetation distribution on Grande Glorieuse

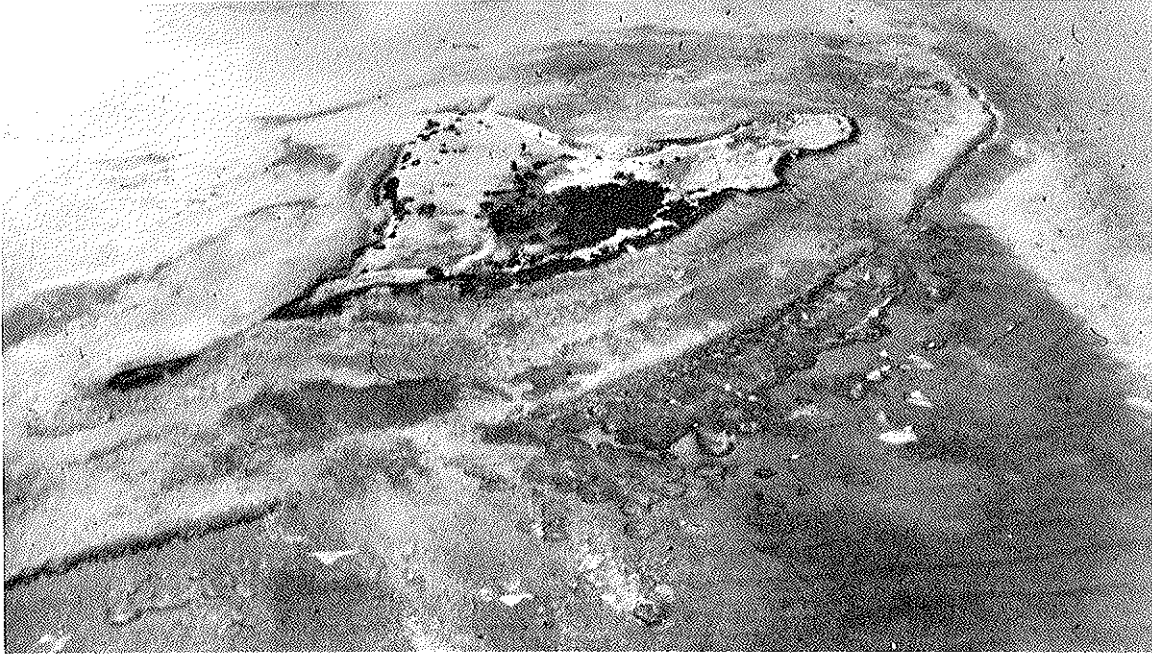


Plate 1. Ile du Lys from the northeast (oblique air photograph by R. Battistini)



Plate 2. Southwest part of Grande Glorieuse (oblique air photograph by R. Battistini)



Plate 3. South coast of Grande Glorieuse, eroded by Cyclone Félicie.
Shrubs of *Scaevola taccada* and *Cordia subcordata* (photo R. B.)



Plate 4. Vegetation on the southern part of Grande Glorieuse: *Scaevola taccada* covered with the parasitic vine *Cassytha filiformis* (photo R. B.)



Plate 5. Ile aux Crabes: coral limestone at the base, covered with bedded detrital limestone, and above this a storm ridge of large boulders. Vegetation of *Pemphis acidula* (photo R. B.)



Plate 6. Mushroom rock and outer rubble ridge. On the horizon the rocks of Cap Vert (photo R. B.)



Plate 7. North coast of Ile du Lys. Foreground: the karst-eroded high-tide platform; background: the low-tide platform with large grooves, the channel, and the outer ridge encrusted with calcareous algae (photo R. B.)



Plate 8. Ile du Lys: the outer ridge encrusted with calcareous algae (Photo R. B.)



Plate 9. Ile du Lys: karst-eroded surface in the extreme northwest, on the bedded *Halimeda* limestones. In the background, the west beach (photo R. B.)



Plate 10. Ile du Lys: basal coral limestone overlain by bedded *Halimeda* limestone, eroded into a projecting visor overlooking the low-tide platform. In the background, the outer ridge (photo R. B.)

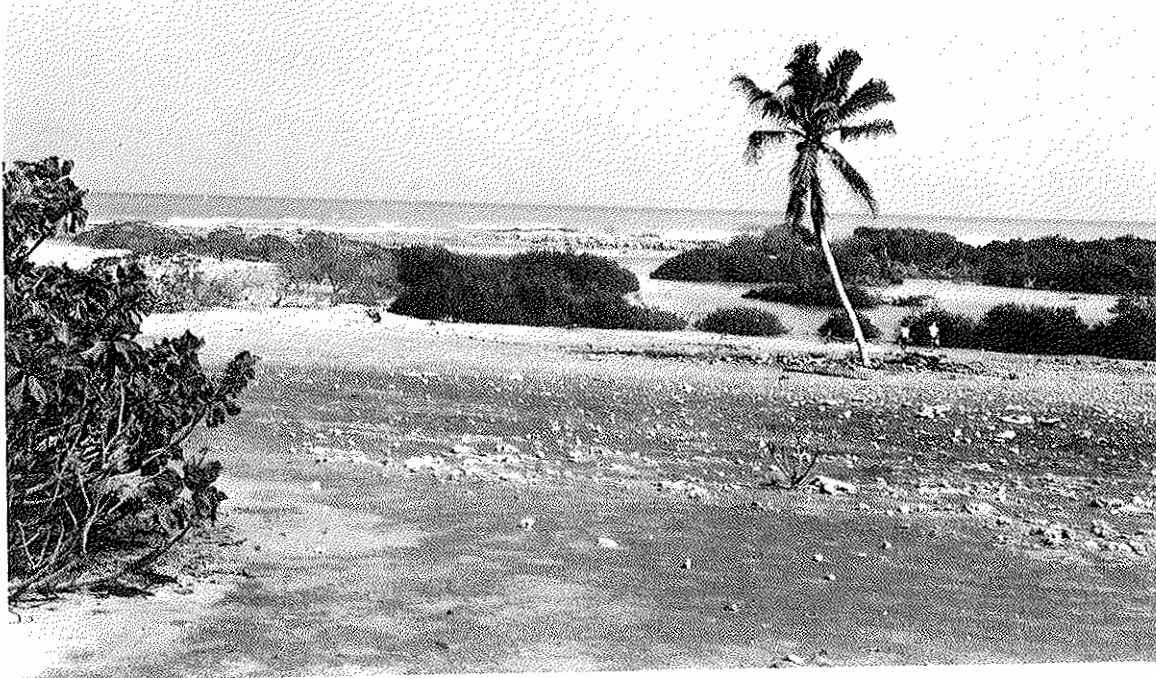


Plate 11. Ile du Lys: the inner pool seen from the southern guano area. Bushes of *Pemphis acidula* round the pool (photo R. B.)



Plate 12. East coast of Ile du Lys: storm beach overlying old bedded detrital rocks. In the background, a seasonal sandspit (photo R. B.)



Plate 13. Grande Glorieuse: depression inland from the dunes, with *Fimbristylis abbreviata*, at the foot of dunes covered with *Cordia subcordata*, *Guettarda speciosa* and *Scaevola taccada*. In the depression one can see traces of lines of dunes now eroded (photo G. Cremers)

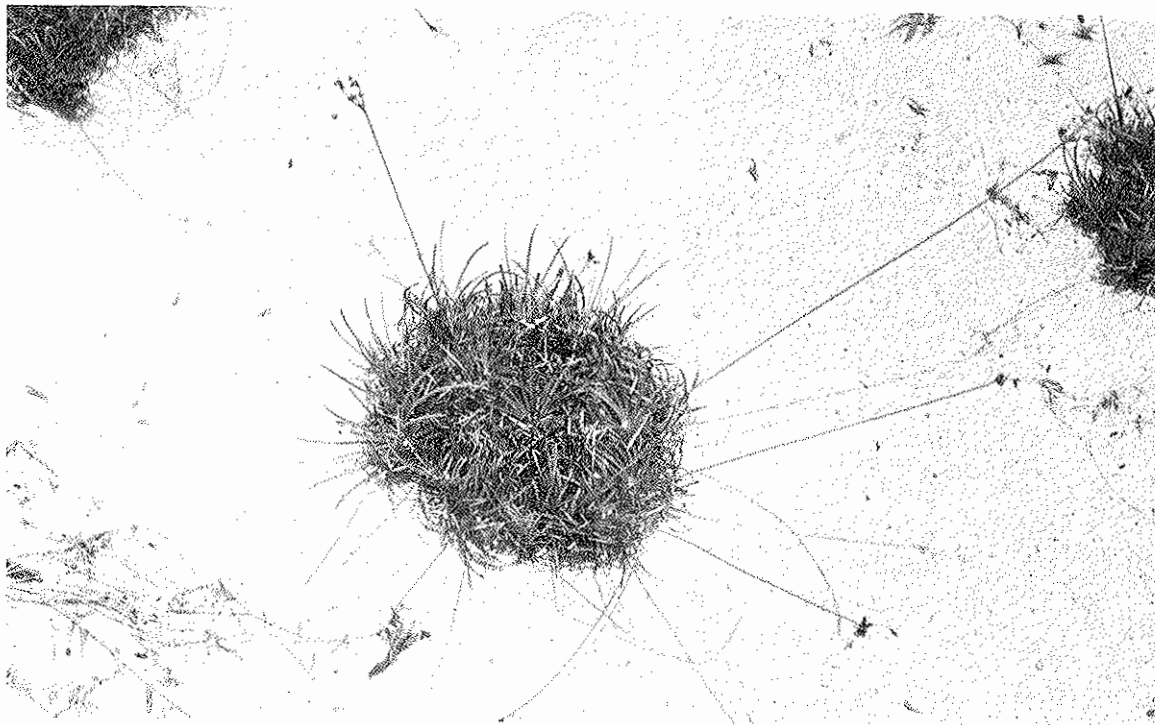


Plate 14. Young tuft of *Fimbristylis abbreviata* on Grande Glorieuse (photo G. Cremers)



Plate 15. Old tuft of *Fimbristylis abbreviata* on Grande Glorieuse
(photo G. C.)

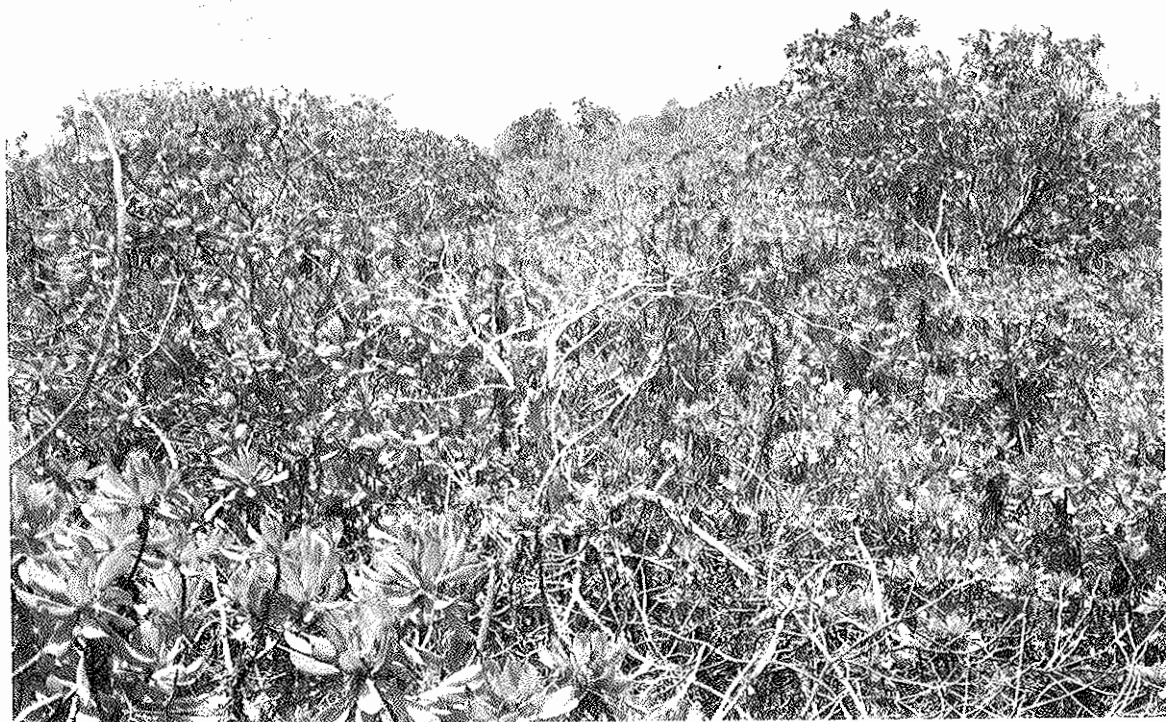


Plate 16. Scrub in the centre of Grande Glorieuse, with *Tournefortia
argentea* and *Scaevola taccada* (photo G. C.)



Plate 17. Zone of *Tournefortia argentea* on the south coast of Ile du Lys (photo G. C.)



Plate 18. Central area of Ile du Lys, with completely dessicated *Boerhavia* sp. In the background, dome-shaped *Tournefortia argentea* (photo G. C.)



Plate 19. Ile du Lys: small pool open to the sea, with numerous bushes of *Pemphis acidula* (photo G. C.)