
Mangroves on Aldabra

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Mangroves on Aldabra

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1. INTRODUCTION

Mangrove trees grow only on sheltered coasts, hence on Aldabra they occur along the shores of the lagoon. In these mangrove communities four species are common and were found in each locality visited. These are *Avicennia marina* (Forsk.) Vierh., *Bruguiera gymnorhiza* (L.) Lam., *Ceriops tagal* (Perr.) C.B. Rob., and *Rhizophora mucronata* Lam. In a few localities only, these are accompanied by one or other of *Lumnitzera racemosa* Willd., *Sonneratia alba* J. Sm., or *Xylocarpus granatum* Koen. The fern *Acrostichum aureum* L. is abundant on Aldabra, sometimes in association with mangroves but more commonly among the maritime scrub where it tends to occur in crevices and solution holes at a slightly lower level than the trees and shrubs of the scrub.

Mangroves occur almost all round the lagoon shores, more commonly in some places than in others, more luxuriantly in some places than in others. Along only a few rocky stretches of the lagoon shores are they absent. Nowhere on the island is there a complete pattern of the zonation described for other Indian Ocean shores by Macnae (1968). On Aldabra the landward fringe is well developed only in one locality and the seaward fringes have rarely developed.

2. THE CONFORMATION OF ALDABRA LAGOON SHORES
IN RELATION TO MANGROVE DEVELOPMENT

The lagoon shores of Aldabra show little variation in general form. All are rocky. In most localities the high tide laps against an undercut cliff which ranges in height from around 25 cm to around 2.5 to 3 m. At the bases of these cliffs the surface is often most uneven, with many boulders derived from collapsed overhangs. The crevices between these boulders and the crevices between the blocks of limestone have become filled with soil and this soil may bury smaller boulders. The shores of the northern islands are for the most part of this nature. Off these shores are numerous small islands, probably remnants of old shore lines. These islands are always high and undercut, often tending to a mushroom shape.

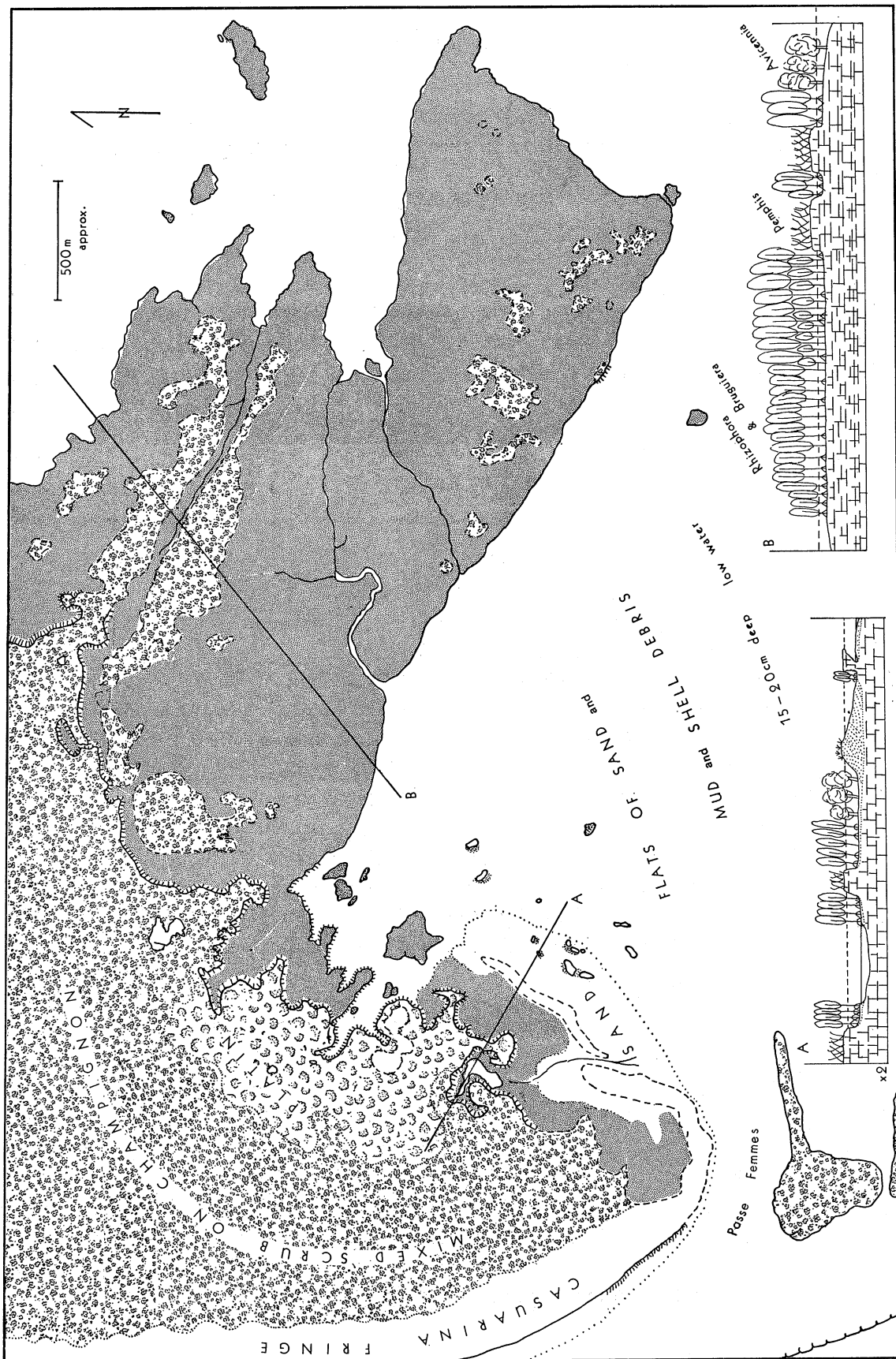


FIGURE 1. Sketch-map of the southern end of Ile Picard adjacent to the West Channels. The transects indicate distribution of the commoner trees.

The shores of South Island tend for the most part to slope gently towards the lagoon but undercut cliffs and rocky hummocks are common.

Soils tend to be deeper along the shores of the northern islands than along those of South Island. But pockets of deeper soil have developed locally.

Sandbanks are uncommon. Three are important to mangrove development.

Within Passe Femme (figure 1), the northernmost of the West Channels, a sandbank reaching above high-water mark extends between the lagoon flats and a mangrove forest behind. This low chenier would seem to be more or less stable varying a little under the influence of the trade and monsoon winds.

Along the line of the watershed, between the Main and West Channels, sandbanks have accumulated against the rocky backbone of Ile Esprit and thence southward past Iles Moustique towards Grand Cavalier on South Island. Iles Moustique are only just emergent at the highest spring tides and form one of the few localities on Aldabra where active colonization by mangroves is taking place. Grand Cavalier is a growing sandspit—growing eastwards, only just emergent at high water. It is one of several similar spits along the north shore of South Island.

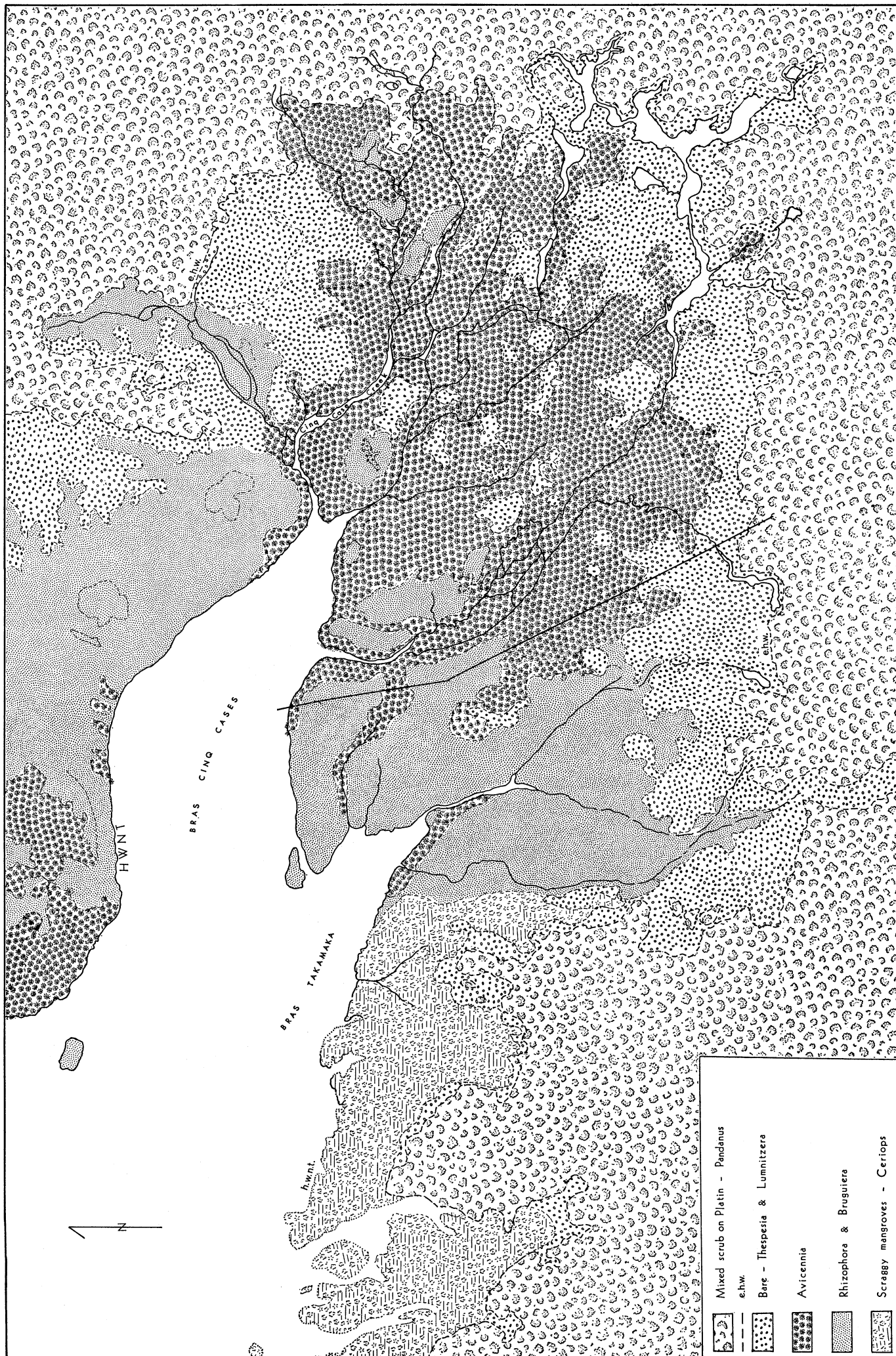
A similar sandspit separates two branches of the eastern channels along the line of Ile Michel and islands to the south of it.

3. THE LANDWARD FRINGE OF MANGROVES

In the southeastern corner of South Island on the platin area *Lumnitzera racemosa* is common in the vicinity of the pools where the salinity ranges between 1.3 and 35 ‰ (data collected by K. G. McKenzie) and also along the lines of waterways which are affected by high water of the extreme spring tides. In these areas *L. racemosa* is associated with, or more frequently occurs lagoonward from, *Acrostichum aureum* and *Pandanus tectorius*. All of these plants grow in soil accumulated in crevices between blocks of platin. As one passes lagoonwards along the lines of the waterways bushes and trees of *Avicennia marina* become more and more common, and *L. racemosa* drops out. The sparse trees of *A. marina* become more common and form extensive groves, an association similar to the *Avicennia* parkland (figure 5, plate 16) on shores of eastern Africa (Macnae 1968, figure 13), but differing in the lack of a herb layer of grasses and saltworts. The occurrence of bare rock and little or no soil prevents their development.

Associated with the trees and bushes in this area are large populations of *Cardisoma carnifex* (Herbst) and of giant tortoises, and on bare patches of sandy soil at slightly lower levels beneath the *Avicennia* trees the fiddler crab *Uca lactea* (de Haan) forma *annulipes* (H.M.-Edw.) may be abundant.

At various localities on South Island, and on Ile Picard bushes of *Lumnitzera racemosa*, of *Avicennia marina* and clumps of *Acrostichum aureum* may be found in solution holes quite far from the lagoon edge but communicating with it through crevices underground. Such tidal solution holes may retain water at low tide or may be dry. If dry the crabs *Cardisoma carnifex*, *Sesarma meinerti* de Man, *Uca tetragonon* Herbst and *U. lactea* f. *annulipes* are abundant. Occasional specimens of *Periophthalmus ?sobrinus* Eggert occur and may construct the nest burrow in such pools. If the pool retains water at low tide, swimming crabs *Thalamita crenata* (Latr.), fish which have wandered in, and medusae *Cassiopeia andromeda* Gm. may be present. This medusa is occasional in the open waters of the lagoon at the edge of mangroves on Ile Picard but the densest



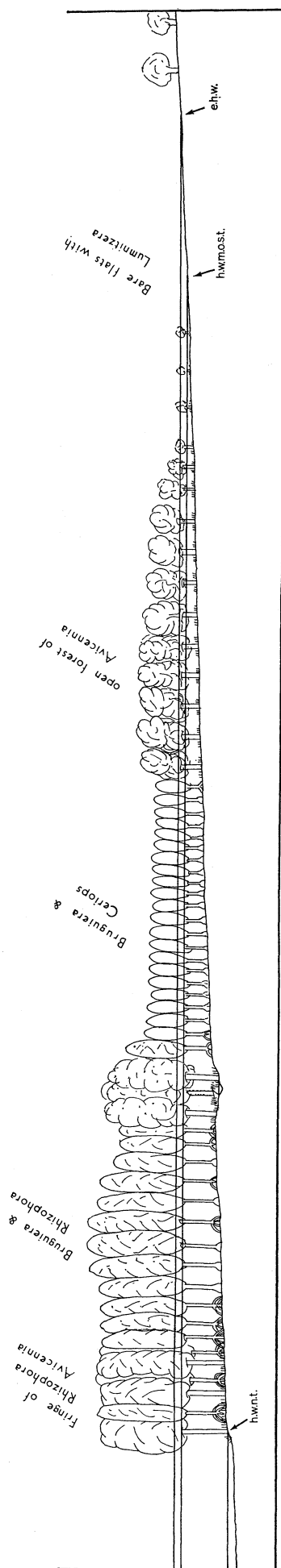


FIGURE 2. Sketch-map of Bras Takamaka to show mangrove distribution. The transect indicates the mangroves in the canopy. The understorey will include younger trees of the same kind and also trees of *Ceriops tagal* will occur beneath *Rhizophora* and *Bruguiera*.

population was seen in a solution hole some 100 m inland on Ile Picard. This species of *Cassiopeia* swims on its back and after a few flicks around settles on the surface of the mud back upwards and continues to feed in this position.

Occasional bushes of *Lumnitzera racemosa* may be found in the splash zone adjacent to bushes of *Pemphis acidula* L. a dominant of the maritime scrub.

Xylocarpus granatum, a tree characteristically found in the landward fringe of continental mangrove forests also occurs at Aldabra. It is abundant on Ile Esprit at the foot of the karst-like pillars of limestone which form the backbone of the island (figure 6, plate 16). This species rarely grows into a decent tree of any commercial value for it has a tendency to go hollow. Its branches sprawl somewhat and may drop, retaining a connexion with the parent tree and continuing to grow in the dropped position. On Ile Esprit most of the trees are old and collapsed and the suckering habit has been encouraged by chopping and using the timber for firewood and charcoal production.

Cardisoma carnifex, *Geograpsus grayi* (H.M.-Edw.) and *G. stormi* de Man were common sheltering among the broken branches, etc. on the ground.

Xylocarpus moluccensis (Lam.) has been recorded by Fryer (1911) from Ile Esprit, but in spite of much searching no specimen was found. This species is very rare in the western Indian Ocean being known from Mafia Island off the Rufiji delta in Tanzania, from one locality on Querimba island (some 600 km southwest of Aldabra) and from a few localities in northwestern Madagascar (some 400 km to the southeast).

Elsewhere on Aldabra *X. granatum* has been recorded from Ile Picard, and South Island (Fryer 1911). I did not find it on Ile Picard. On South Island it was common at Grand Cavalier and sporadic around Takamaka. At both localities shrubs and ill-grown trees of some 3 to 5 m tall were growing among rocks at the base of the cliffs. No doubt this species is sporadic all along the coast of South Island.

The occurrence at Anse Var of a group of *Hibiscus tiliaceus* L. is worthy of note. This species is commonly called a freshwater mangrove and usually occurs on wet ground at the back of a mangrove forest, often above salt water influence but not above tidal influence. Its

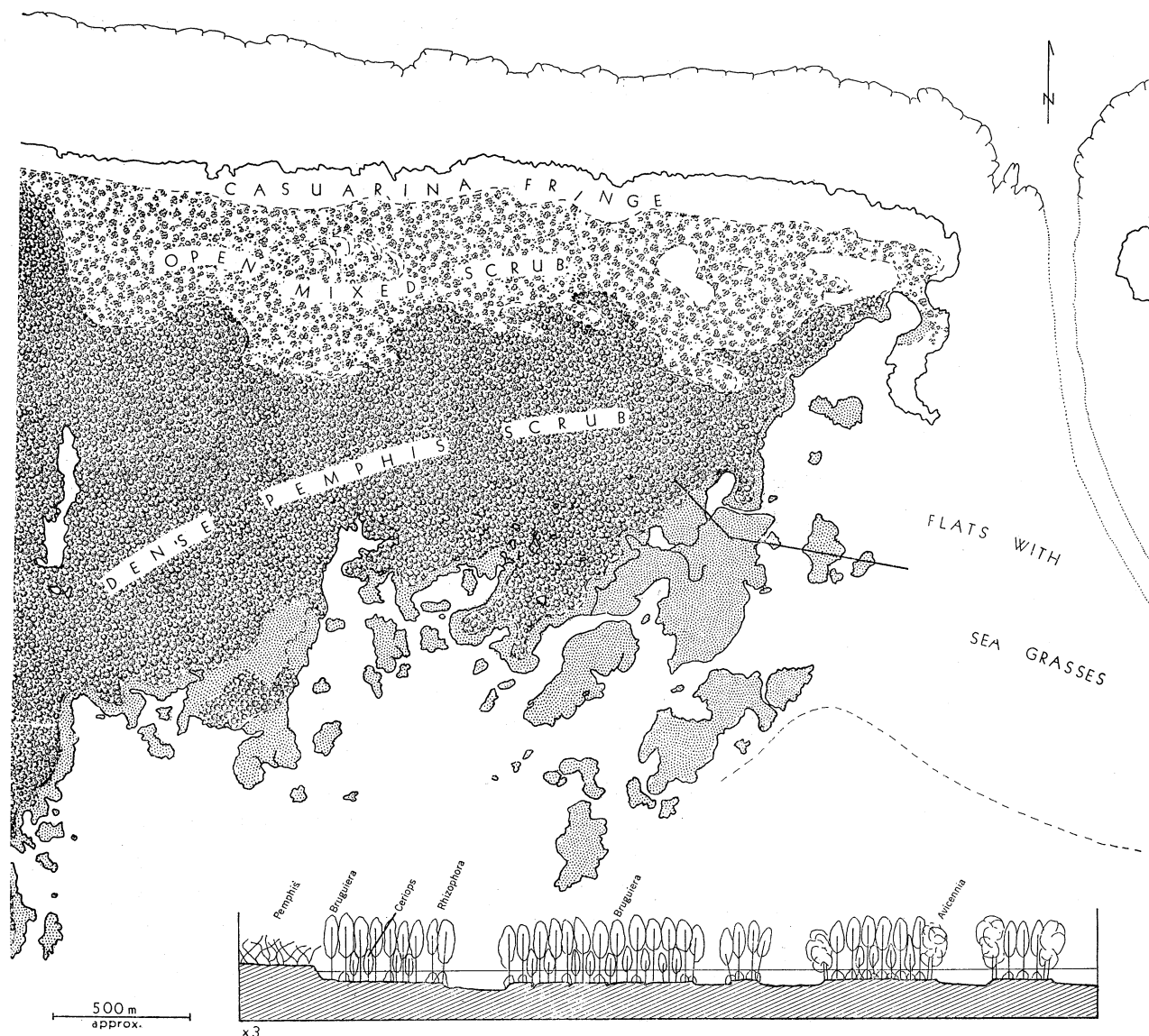


FIGURE 3. Sketch-map of distribution of mangroves on Middle Island near East Channel (cf. figure 8, plate 17).

occurrence here on a pocket beach at extreme high-water mark is no doubt to be explained by the chance grounding of a fertile fruit.

Species of *Thespesia* are often associated with *Lumnitzera racemosa* on well drained sandy soils under saline influence. At Aldabra *Thespesia populneoides* occurs with *L. racemosa* in the vicinity of saline pools where the salinity is lowish to intermediate. At the lowest salinities *Pandanus tectorius* is common.

Acrostichum aureum is widespread on Aldabra, and one meets it in most unexpected places. On continental shores it is associated with the mangrove landward fringe and only rarely occurs away from the influence of salt water—it does not reach into the maritime scrub vegetation. But at Aldabra it is an important constituent of this vegetation. There is, however, no doubt that, in most places where it has been found, the open water nearby is salty. Measurements of



FIGURE 4. *Acrostichum aureum* growing in crevices of platin near Takamaka salt pool: *Pemphis* scrub behind.



FIGURE 5. Open 'parkland' of *Avicennia marina* near Cinq Cases Creek. (Photo P. Grubb.)



FIGURE 6. *Xylocarpus granatum*, typical mauled tree growing near 'karst pillars' on Ile Esprit.

(Facing p. 242)



FIGURE 7. *Bruguiera gymnorhiza* (thick black stems) and *Ceriops tagal* (thinner paler stems) growing at base of undercut cliff near East Channel.

FIGURE 8. *Rhizophora mucronata* fronting creek near East Channel, such trees are used for nesting by frigate birds, boobies and blue pigeons.

alinity made by K. G. McKenzie show it associated with pools ranging in salinity from 1 up to 29.7 ‰. Since saline pools are widespread, and their presence suggests a considerable dispersion of saline ground waters, it comes as no surprise that *A. aureum* turns up in apparently unexpected places. In many continental areas species of *Acrostichum* give the impression of being opportunist (Watson 1928; Macnae 1968). This too, is true of Aldabra, where as a result of an apparent lack of competition for growth space, *A. aureum* has become more widespread than one might have expected. Also it is not normally grazed by tortoises which appear to eat most plants with leaves within their reach.

4. THE FORESTS OF *BRUGUIERA* AND *RHIZOPHORA*

On continental shores with a considerable tidal range zones occupied by species of *Bruguiera* and *Rhizophora* are conspicuously and readily separated. At Aldabra this distinction is much less easily recognized. Two variants occur.

(a) *High forests*

High forests occur commonly along the northern shores of the lagoon and at isolated localities on the southern shores. Such forests are sporadic from Petit Cavalier eastward to Grand Cavalier, common in the southeast around Bras Takamaka and Cinq Cases Creek.

A fringe of *Rhizophora mucronata* always borders creeks except at their mouths into the lagoon where a seaward fringe of *Avicennia marina* edges the creek. The creek fringe of *Rhizophora* may be several metres wide, dense and difficult to penetrate. Behind it is a mixed forest made up of tall trees of *R. mucronata*, *Bruguiera gymnorhiza* and *Ceriops tagal*. The canopy is closed and uniform, shared between *Rhizophora* and *Bruguiera*. *Ceriops* along with younger trees of the other two species forms an understorey. The numbers of these three species vary slightly from one forest to another. The average of five counts of the twenty trees immediately in front of the observer on Ile Picard was 10 *Rhizophora*, 6 *Ceriops*, 6 *Bruguiera*; at Grand Cavalier 2 *Rhizophora*, 13 *Bruguiera* and 7 *Ceriops*; at a locality just west of Takamaka Camp the numbers were 10 *Rhizophora*, 5 *Bruguiera* and 5 *Ceriops*.

A mixed forest of this type occurs among the islands within East Channel (figure 3) and along the lagoon shore of Middle Island. Here as might be expected, *Rhizophora* is much more common, the other species being crammed back, up against the cliffs (figure 7, plate 17). The trees which fringe the channels leading to the lagoon are occupied by nesting colonies of boobies and frigate birds (figure 8, plate 17).

The fauna of this high forest is rather sparse and as usual reticent. *Cardisoma carnifex* is common at the upper edges. *Sesarma meinerti* and *S. smithi* H. M.-Edw. are abundant; the former constructs hooded burrows, the latter builds its burrows into turrets placed against trees, rocks or more rarely free-standing. A small elusive sesarmine, a species of the subgenus *Chiromantes* and specimens of *Helice leachii* Hess are common but difficult to capture. Specimens of *Terebralia palustris* L. are common in wet muddy patches and a species of *Melampus* hides under twigs and leaves. *Uca gaimardi* (H.M.-Edw.) is abundant (but difficult to catch), particularly close to gullies and creeks. *Periopthalmus ?sobrinus* is common and widely distributed.

In many places, as for example along the shores of Middle Island, the trees come down to

a level where water is almost always present. In such situations the fauna of the *Thalassia* beds below, may be found among the roots of the mangrove trees.

(b) *Thickets and low forests*

Occupying a similar intertidal level on South Island at places between Grand Cavalier and Takamaka is a variant of the *Rhizophora-Bruguiera-Ceriops* forests. Here the mangroves form a more or less open community of scattered trees or small copses isolated from one another. The trees are usually about 2.5 to 6 m high and rarely taller. These open communities are dominated by *Ceriops tagal* with an admixture of many shrubs or small trees of *Rhizophora mucronata* and occasional shrubs or small trees of *Bruguiera gymnorhiza*. Small trees of *Avicennia marina* occur towards the seaward limits. These *Avicennia* trees are never tall and always show a disproportionate circle of radiating roots indicating that the trees are older than they seem. The taller trees of *Ceriops*, *Bruguiera* and *Rhizophora* often show a crown of dead, bare branches giving a stag-headed appearance. This is probably the result of starvation in a poor soil.

Occasional clumps of tall trees occur in patches where the soil is deeper and a mangrove peat has accumulated. Such clumps are scattered through the whole of this stretch of the island. The fauna is similar to that of the high forest with species of *Uca* being more conspicuous.

5. THE SEAWARD FRINGES

On continental shores seaward fringes of *Avicennia marina* or *Sonneratia alba* (or other species of these genera) lead the advance of the mangrove forests on to the banks of sand and mud accumulating on the shore. At Aldabra shores of this type are rare. Only on Iles Moustique do extensive young groves of *Avicennia* occur along the bank of sand and mud on the watershed between Main and West Channels.

Elsewhere occasional old trees of *A. marina* persist as remnants of an actively growing seaward fringe. Such trees occur round the islets along Middle Island, along the lagoonward edge of Bras Takamaka and Bras Cinq Cases. They also front the eastward face of the large mangrove forest on Ile Picard and its southern face at Entre Deux.

A concentration of trees and bushes of *A. marina* has developed behind the sandspit at the west end of Ile Picard. Here too grow a few trees of *Sonneratia alba*. A group of three old trees of *S. alba* grows in a sheltered corner of an islet across Passe Femme. Apart from a single tree on Iles Moustique, these few trees on either side of Passe Femme are the only trees of this species on the island.

The fauna of the seaward fringes on Iles Moustique and at Passe Femme is dominated by *Uca tetragonon* and *U. lactea* f. *annulipes*. Occasional nests of *Periophthalmus ?sobrinus* were encountered and in wetter places large numbers of *Terebralia palustris* crawl around. *Cerithium* sp. is also common in such damp places.

6. DO THE NESTING BIRDS AFFECT MANGROVES?

Diamond has shown that the sea birds, particularly the boobies (*Sula sula* L.) and the frigatebirds (*Fregata* spp.) seem to have a preference for certain types of mangrove forests. These birds seem to prefer the narrow belts of tall or high forest occurring round the islets at certain localities on Middle Island, and the fringes of tall *Rhizophora* trees along stretches of creeks in Bras Takamaka. Egrets and herons also nest among mangroves on Iles Moustique and

on an island between East Channel and Bras Takamaka. Isolated trees at the edge of the islets farthest into the lagoon may be used as perches and become leafless or stag-headed. The accumulation of faeces does not seem to affect the tree in the nesting areas but it may add to the fertility of the soil.

7. DISCUSSION

From this description it is clear that the mangroves of Aldabra do not fit into the pattern of zonation shown on continental shores. But the differences seem to be due to peculiarities of Aldabra rather than to peculiarities of islands.

Mangroves require soil in which to grow. Soil is scarce on Aldabra. Any soil present must be locally derived. The only sources, therefore are from residues left by solution; from debris accumulating from broken shells and broken coral with some humus derived from the vegetation of the island; and from the feeding activities of such animals as crabs and chitons. The species of *Grapsus* and the chitons feed by scraping off the surface layers of the limestones to feed on the blue-green algae which have etched and softened the outer few millimetres by growing on and in the rock.

Accumulations of such soils are local. The greater part of the lagoon shores are underlain by platin. This is smooth, criss-crossed by crevices, a few centimetres to several metres wide, and interrupted by large solution cavities. These crevices and solution cavities were, presumably, colonized by mangroves. Once mangroves became established the rate of deposition would increase and in due course soil has come to cover much of the rock surface to a depth of several centimetres. By their mode of growth mangrove trees require only a little soil, all are shallow rooted. The presence of crevices in the underlying rock gives the hold required by the colonizers and pioneers and in due course when a mature forest has been established the interlacing of cable roots forms a mangrove peat, dense, black, and fine-grained with much fibrous material, and a thin layer on the surface in which are found the young, living, nutritive roots. In solution holes within the forest this peat becomes water-logged, and very slimy. Highly organic soils of this type are found in all the high forests of *Bruguiera* and *Rhizophora* and give the impression that these forests are the oldest and most highly evolved on the island.

Younger soils of a white marly clay support the low forests and thickets so characteristic of the north shore of South Island. These are clearly insufficiently fertile to support a high forest.

The soils around the islets off Middle Island are of two types. Mangrove peats have accumulated against the rocky cliffs among the tall trees. The pools and channels are underlain by an ill-consolidated soil with much shell and coral debris, often coloured pink, perhaps by photosynthetic bacteria (B. A. Whitton, personal communication).

A detailed study of the marine soils of Aldabra would seem to be worthwhile in order to explain some of the peculiarities of distribution of the mangrove trees. One needs also to know more about the distribution of currents along and against the shores of the lagoon and of the patterns of deposition of material under their influence, and under the influence of the winds which modify the tidal currents.

One wonders too, what changes have taken place in mangrove distribution. Unfortunately the early chart was not surveyed in sufficient detail. One suspects that the mangrove island of Iles Moustique is not present on this chart, being represented by a sandbank only. Similarly, the small peninsula of Grand Cavalier seems to be represented by an offshore island. If this is so then there has been considerable accretion in this area.

Capt. W. J. L. Wharton (1883) states that: 'The mangrove has established itself on the edges of the lagoon—and in all places where it has done so, tortuous creeks or little gorges run back into the coral, filled with mangrove trees—which stretch out their roots toward the coral walls around them and as it seemed indubitably to me, in some way decompose the softer parts and eat their way in. The island is riddled with these creeks, always filled with mangroves, and opening into the lagoon.

'The outer face of the island is of course being slowly undermined by the sea at high water, presenting overhanging cliffs impossible to scale, and the island is wearing away from that cause also, but the destruction from the mangrove is much more important, and at no very distant period, as it seemed to me, the upraised island will be again reduced to its original level as an ordinary atoll.'

Is the mangrove in fact responsible for this erosion? There is no doubt that the mangrove roots particularly those of *Avicennia* have often etched a pattern on the underlying limestone but I doubt if they were responsible for the pattern of creeks and gorges described by Capt. Wharton and ascribed by him to erosion by mangroves. It is more likely that the presence of these lines of weakness, expanded by solution at the air-water-rock interface afforded the possibility of colonization by mangroves but once established they may have assisted in splitting the rocks apart by their growth. However, the mangrove root crowns and the peat accumulated round these root crowns may act as erosive agents. Mangrove peat rarely becomes acid, the high degree of buffering in sea water prevents this, but it will be a medium for ion exchange. F. R. Fosberg (personal communication) comments that he has seen both in the Marshall Islands and in Florida what seem to be good examples of limestone being changed to marl around mangrove roots.

8. WHENCE CAME THE MANGROVES?

In that portion of the western Indian Ocean which is under the influence of the South Equatorial Current we find the same assemblage of mangrove trees as on Aldabra. This area involves Mauritius and Réunion, Madagascar and Eastern Africa. Mangroves are not present in the Chagos archipelago (J. D. Taylor, personal communication). The same assemblage of mangroves also occurs in the Seychelles but it has been largely cut out there. Sauer's (1967) record of *Sonneratia caseolaris* (L.) Engl. is apparently an error, *S. alba* is the only representative of this genus there. In all these areas the form of *Bruguiera gymnorhiza* is the western form with yellowish calyx segments, in this differing from the eastern form which characteristically, has reddish calyx segments.

The uniformity of the mangrove assemblage of species in this area would suggest an original interdependence. There are two possibilities of the direction of colonization: (i) they came from the east, sea-borne, (ii) they crept along the northern shores of the Arabian Sea and thence down the African Coast. The absence of mangroves from the Chagos archipelago is against the former hypothesis. In favour of the second are the affinities of the general land flora, and the current systems. The flora of Aldabra shows strong African and Madagascan affinities. Currents in the area tend to come from the southeast. Evidence for this came to Aldabra during January 1968, when trees uprooted in northern Madagascar by the hurricane 'Georgette' came ashore. Further the captain and the chief officer of the bulk carrier *Cementia* told me that they had encountered many trees between Aldabra and Madagascar in the voyage from Mombasa to Réunion and return during January to March 1968. Such groundings of Madagascan trees could well have brought mangroves to Aldabra. Fruits could similarly travel and colonize.

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FIGURE 4. *Acrostichum aureum* growing in crevices of platin near Takamaka salt pool:
Pemphis scrub behind.



FIGURE 5. Open 'parkland' of *Avicennia marina* near Cinq Cases Creek. (Photo P. Grubb.)



FIGURE 6. *Xylocarpus granatum*, typical mauled tree growing near 'karst pillars' on Ile Esprit.

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FIGURE 7. *Bruguiera gymnorhiza* (thick black stems) and *Ceriops tagal* (thinner paler stems) growing at base of undercut cliff near East Channel.

FIGURE 8. *Rhizophora mucronata* fronting creek near East Channel, such trees are used for nesting by frigate birds, boobies and blue pigeons.