マングローブ林の防災機能に関する研究 (II) : ソロモン諸島マライタ島のランガランガラグーンに見られるマングローブ林について(林学科)

Studies on the Protective Functions of the Mangrove Forest against Erosion and Destruction

(II) On the Mangrove Forest in the Langa langa Lagoon, Malaita, the Solomon Islands

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INTRODUCTION

In November 1978, the author had visited Guadalcanal Island, Malaita Island and Florida Group in the Solomon Islands for the pre-survey on the mangrove forest.** It is the purpose of this paper to discuss about the mangrove forest in the Langa langa Lagoon, Malaita, with figures and point out the effectiveness of the protective functions of the mangrove forest against erosion and destruction. The outline of the Solomon Islands will be described below mainly according to the descriptions of the quoted literatures by Hansell [3] and the British Solomon Islands Protectorate Government. [7,8]

The Solomon Islands comprise a central linear group of six major islands, Choiseul, New Georgia, Santa Isabel, Guadalcanal, Malaita and San Cristobal, in the form of a double chain, extending in a north-west south-east direction over 800km of the tropical south-west Pacific between latitudes 6°35′ and 11°40′ S, and longitudes 155°30′ and 167°E. Peripheral to and intermingled with these are many small islands, atolls and reefs, some as much as 850km from the nearest major island. The Solomon Islands lie about 1,600km to the north-east of the Australian mainland, 1,400km to the east of Papua New Guinea and to the north-west of Fuji and the New Hebrides. The main islands are rugged and vary between 150km and 190km in length and between 30km and 50km in width. The total land area is 28,896km^2 and the largest island, Guadalcanal, has an area of 5,625km^2. Fig.1 shows the location of the Solomon Islands and the Langa langa Lagoon.

The Islands lie directly along a major line of crustal weakness trversing the western Pacific and are essentially surface expressions of fault-bounded blocks and troughs originating in a zone of geologically intense activity. Typically the large islands have a mountainious spine which on one side drops down steeply to sea level and on the other drops through a series of foothills to the coast, therefore these north-east coast have the only extensive coastal plains. Except for the coral atolls and the raised coral reefs, the cores of most islands are of igneous and metamorphic rocks in the Cretaceous-Miocene which are overlaid with considerable thickness of marine sediments in the Miocene-Pliocene. The recent emergence of the islands has in parts overlaid these rocks with level-topped terraces of coral reef rock. There are extensive coral reefs and lagoons around many of the islands.

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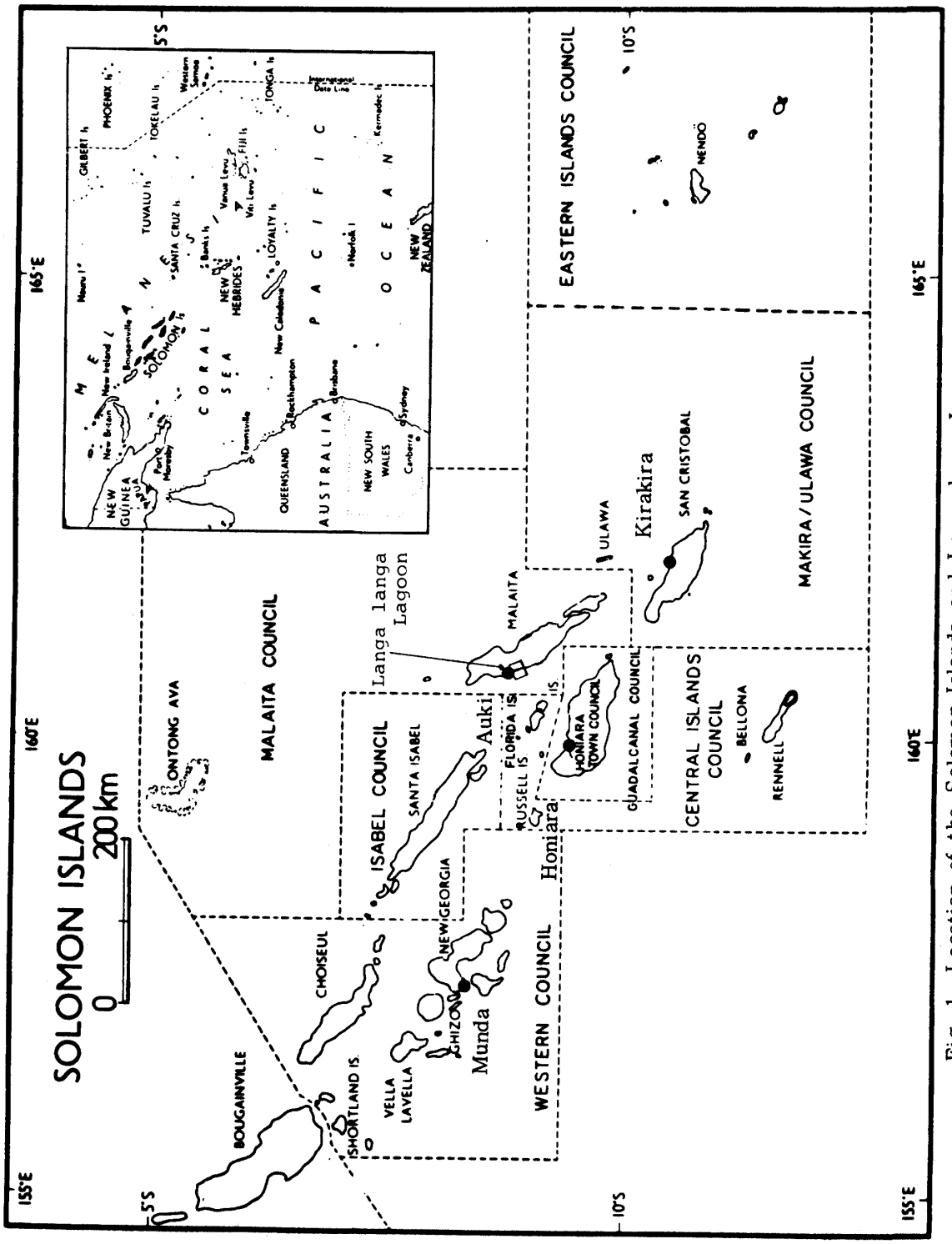


Fig. 1 Location of the Solomon Islands and Langa langa Lagoon

The Islands lie in a broad belt, known as the inter-tropical convergence zone, of generally low pressure projecting south from the equator where the north-east and the south-east trade winds meet. The ascending air movement is controlled by the apparent seasonal swing of the sun over the equator and dynamic processes which connect air masses of different pressure. In contrast to the rain fall figures, temperature data show a high degree of uniformity and it is a wet tropical characteristic. [5] In lowland areas the variation of mean monthly screen temperatures is about 1°C betweeen extreme monthly means of 25.7°C to 26.7°C at Dala, Malaita, for example. [3] Rainfall is often heavy, particularly in the inland areas on the windward side of the main islands. Coastal areas of the large islands sheltered from the prevailing winds are usually drier than other parts. The annual rainfall may be as much as 8,000mm in the high mountains but generally averages 3,000mm - 4,000mm. From the end of April until November the south-east trade winds blow almost continuously but with vary intensity. Betweeen November and April the weather is more uncertain, most of the winds south-east. In this season there are long periods of calm, which are punctuated by squalls, sometimes severe and sometimes by the build-up of cyclones. The incidence of tropical cyclones, north of latitude 13°S and between 140° and 165°E in the period 1948 - 1974, is 1.2 on the average between zero and three. [3] More detailed meteorological data are shown in Table.1.

Table 1. Meteorological data[7,8]

◦ Average annual rainfall (1963～1977)			* (1965～1977)
Honiara	Munda	Auki	Kirakira*
2232.1 mm	3644.9 mm	3522.9 mm	3908.7 mm
◦ Temperature (only Honiara)			
Mean daily maximum		(1976)	31.0 ℃
Mean daily minimum		(1976)	21.5 ℃
Highest recorded	(17th, Dec., '71)		34.8 ℃
Lowest recorded	(4th, Aug., '75)		18.4 ℃

For the most part, the islands are covered with a dense rain forest, but on Guadalcanal and Florida Island there are extensive tracts of rough grass on the northern plains and foothills where the soil is generally good and there is abundant water. The total forest area is 24,930km^2 including the low mangrove forest area of 80km^2 and the tall mangrove forest area of 562km^2 without degraded forest areas and non-forested areas. Malaita Isalnd has the total forest area of 3,589km^2 including the low mangrove forest area of 14km^2 and the tall mangrove forest area of 110km^2.[3]

METHODS

With the hydrographic map and a guide to go upon, the author started for the pre-survey from Auki by a boat attached with an engine and observed visually on the states of the mangrove, the sediment and

detailed features along some creeks in the coastal mangrove forest and went round islands, sometimes ashore for the observations on the states of mangrove, reef, elevation and composition of the ground. Depth was compared with the hydrographic map, sediment was observed and the view of point away from boat was looked through a field glass. The local names of mangrove, on-the-spot circumstances, traffic and transport by boat and canoe were inquired of the guide about.

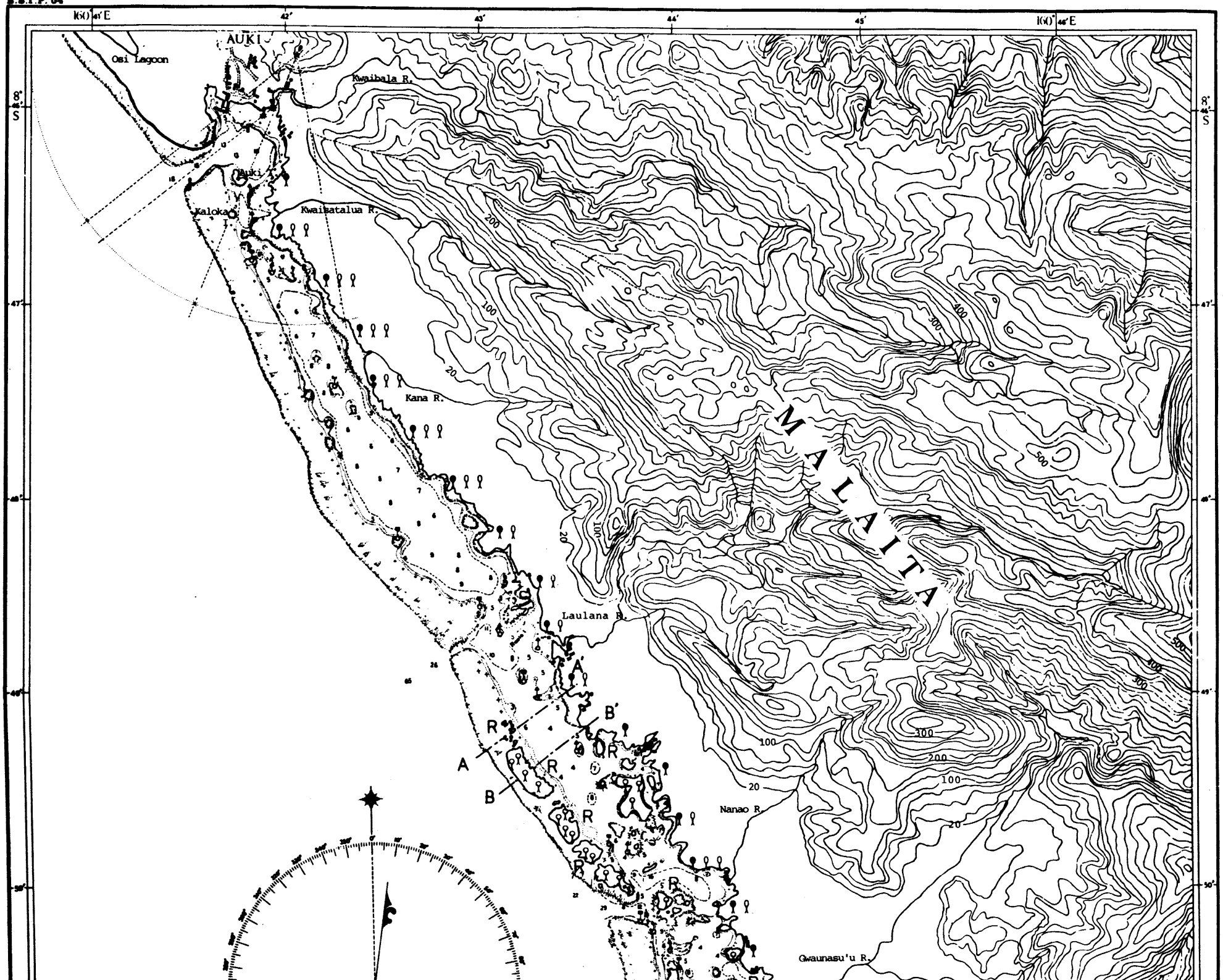
RESULTS AND DISCUSSION

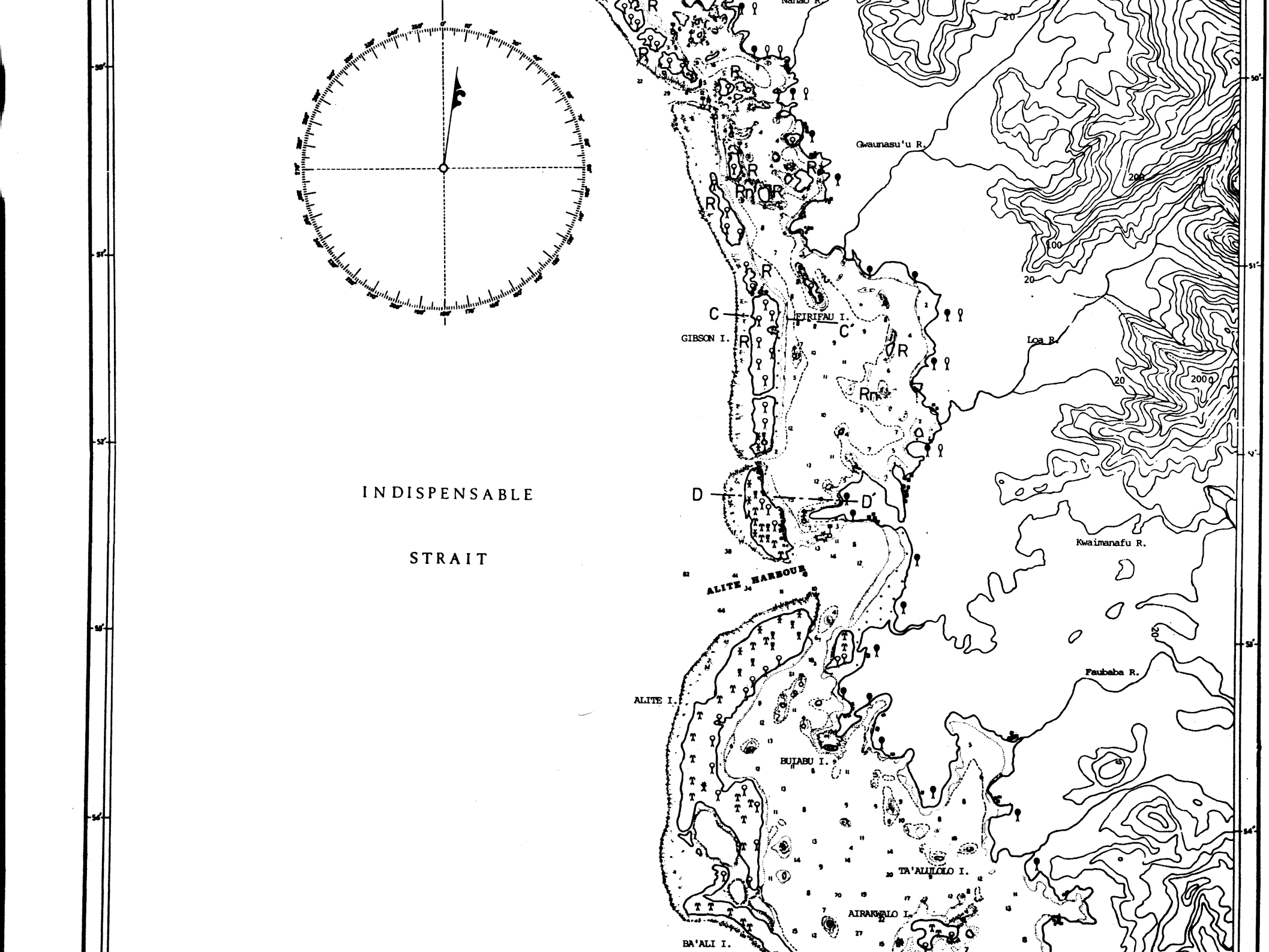
The conditions of this lagoon, for example, disposition of islands, vegetation, hamlets and depth, are shown in Fig.2. It was understood, by comparing in detail the hydrographic map with on-the-spot situations, that it was made pretty well. But the islands in it include what are not considered with the island in the strict sense. Mangrove forests which looked like islands are established on reef directly or coral debris which overlay reef and do not have the ground above the sea surface. They are shown as R or Rn in Fig. 2. The inner appearance of *Rhizophora* forest is shown in Photo. 1. The author stands on tangle root system above the sea surface. The seaward pioneer is shown in Photo. 2. The *Rhizophora* small forests established at the northern end of this chain of islands are shown in Photo. 3. It is supposed that Rn were established recently because those are shown as reefs in the hydrographic map. The mangrove forest along the shore of Malaita mainisland, especially from Auki to the river mouth of Laulana River, consists of low mangrove forest which has a low canopy and in which *Rhizophora* spp. are most common and tall mangrove forest composes of a little more mangrove species. The mangrove forest fringed islands in the lagoon consists mainly of *Rhizophora* sp. and locally of *Sonneratia* sp. and *Avicennia* sp. The mangrove species in the Langa langa Lagoon confirmed afterwards with some literatures[1,2,3,4,9] are shown in Table 2. Besides them, unconfirmed some other species had been seen.

Table 2. Main species of mangrove in Langa langa Lagoon

Chain of islands	coast of mainisland
Rhizophora stylosa Griff.	*R. stylosa* Griff.
	R. apiculata Blume
	R. mucronata Lamk
Avicennia eucalyptifolia Zipp. ex Miq.	*A. marina* (Forsk.) Vierh.
	A. alba Bl.
Sonneratia alba Sm.	*Bruguiera gymnorrhiza* (L.) Lamk
	B. sexangula (Lour.) Poir.
Aegiceras corniculatum (L.) Blanco	*Nypa fruticans* Wurmb

The profiles of the lines A — A', B — B', ···, E — E' in Fig. 2 are shown in Fig. 3. From Fig. 3, it is obvious that root system of *Rhizophora* spp. has the function to trap sediments. The forests in Photo. 3 trap little coral debris yet. It has a general tendency to change finer from seaward side to inside. It is assumed that the source of debris is the seaward edge of coral reef and coral sand by com-


160° 41' E
42'
43'
44'
45'
160° 46' E
8° 46' S
47'
48'
49'
50'
AUKI
Auki
Osi Lagoon
Kwaibala R.
Kwaisatalua R.
Kalokao I.
Kana R.
Laulana R.
Nanao R.
Gwaunasu'u R.
MALAITA
200
100
20
400
300
500
A
A'
B
B'
R


INDISPENSABLE
STRAIT
Nanao R.
Gwaunasu'u R.
FIRIFAU I.
GIBSON I.
Loa R.
Kwaimanafu R.
ALITE HARBOUR
ALITE I.
Faubaba R.
BUIABU I.
TA'ALULOLO I.
AIRAKWALO I.
BA'ALI I.
C
C'
D
D'
R
20
100
200
50'
51'
52'
53'
54'

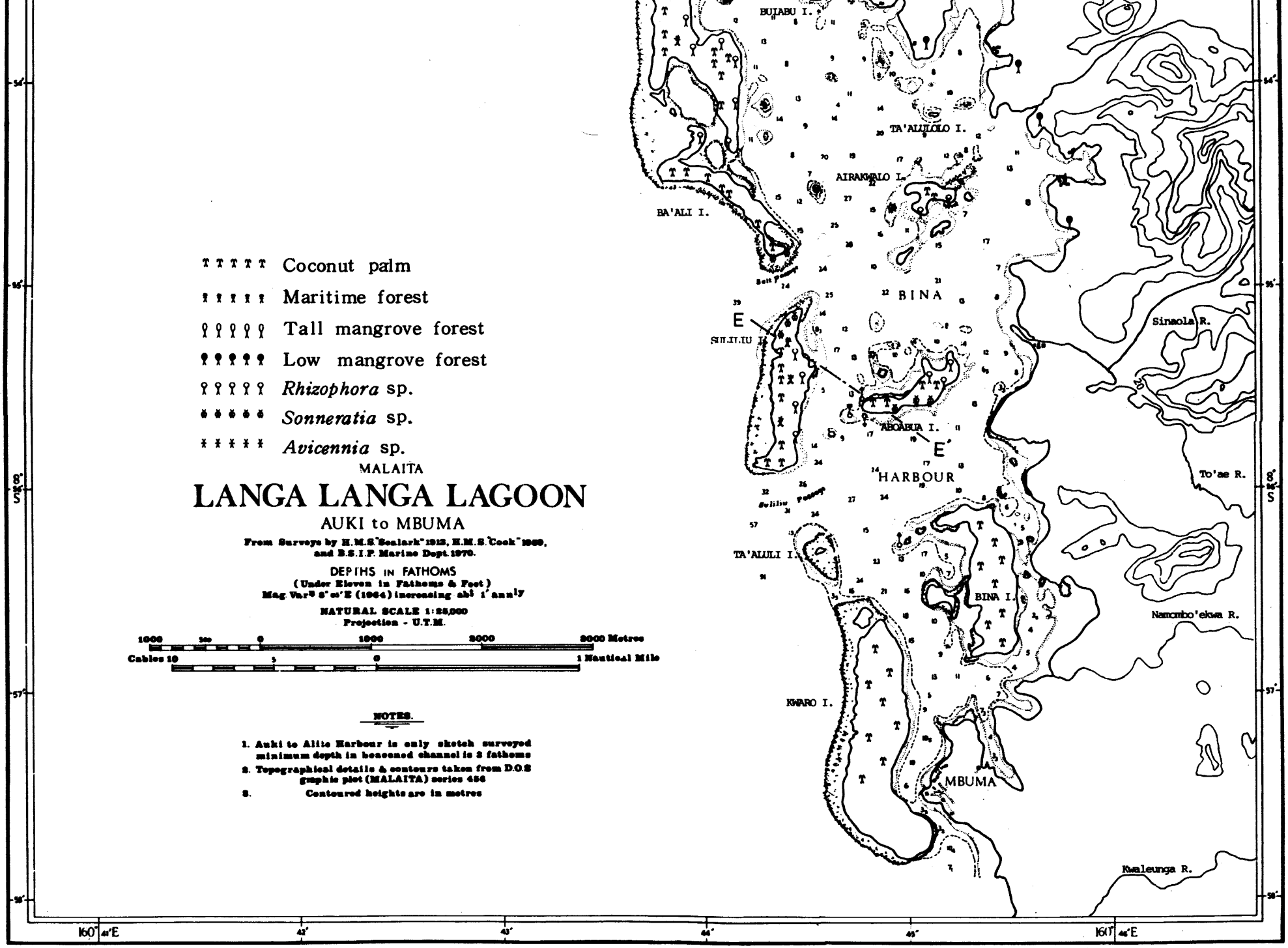


Fig 2. The Langa langa Lagoon, Showing distribution of mangrove, hamlets and depth

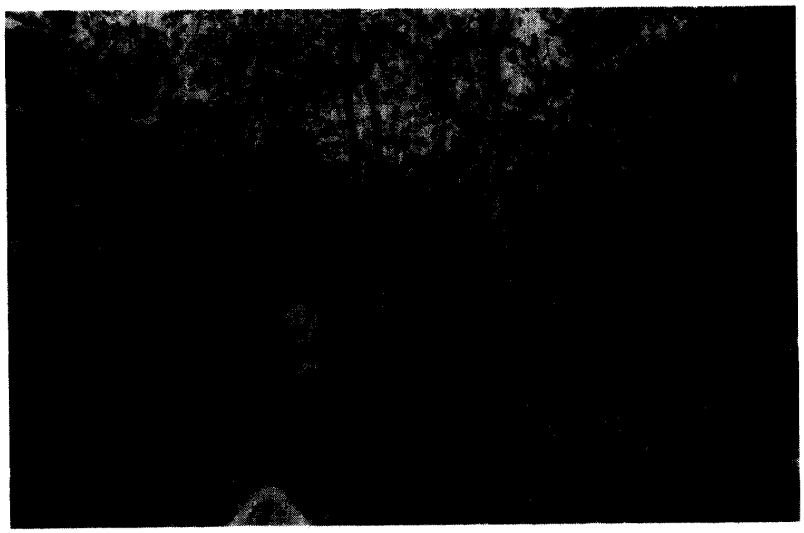


Photo 1.
Inner appearance of a forest shown as R in Fig. 2

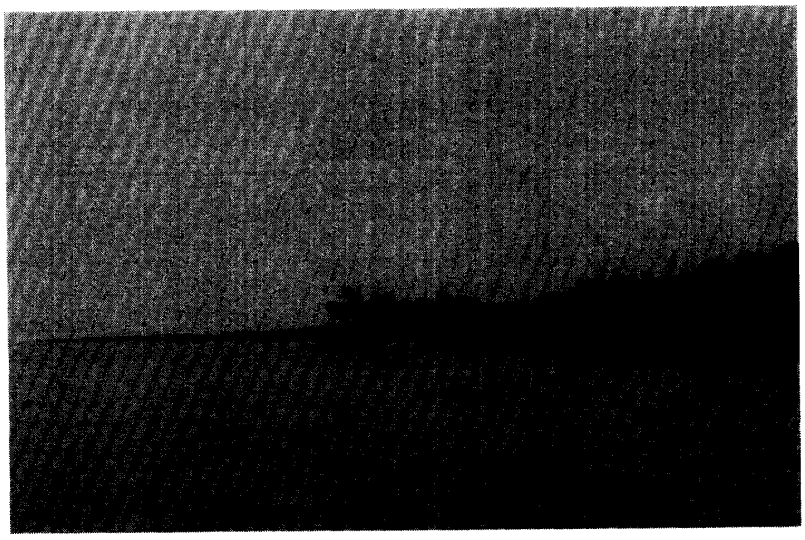


Photo 2.
Seaward pioneer

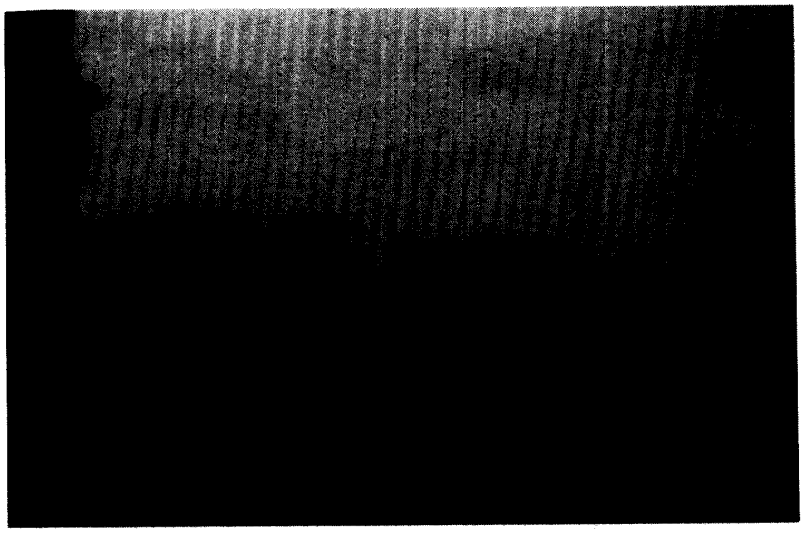


Photo 3.
Rhizophora forests

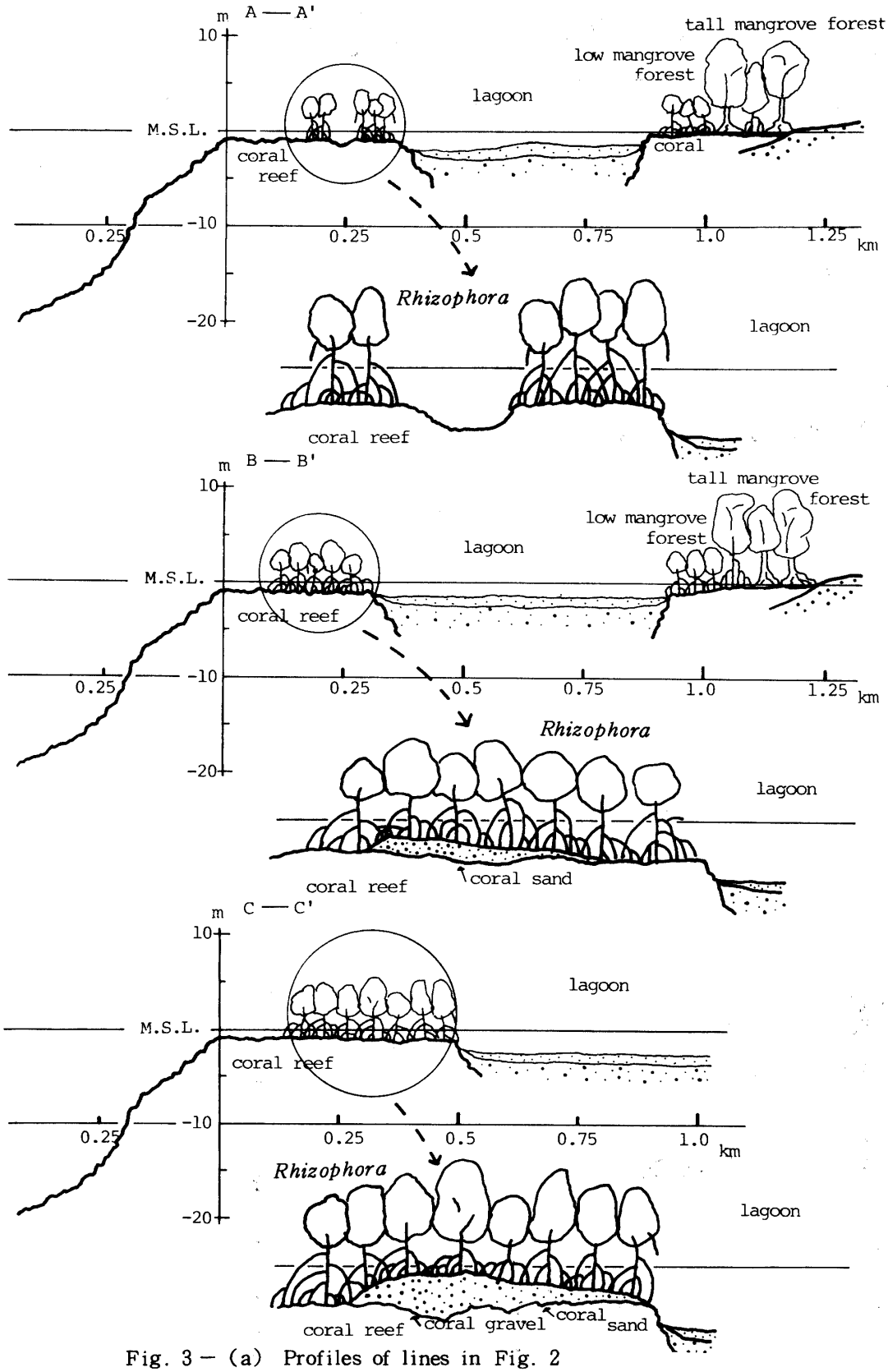


Fig. 3 — (a) Profiles of lines in Fig. 2

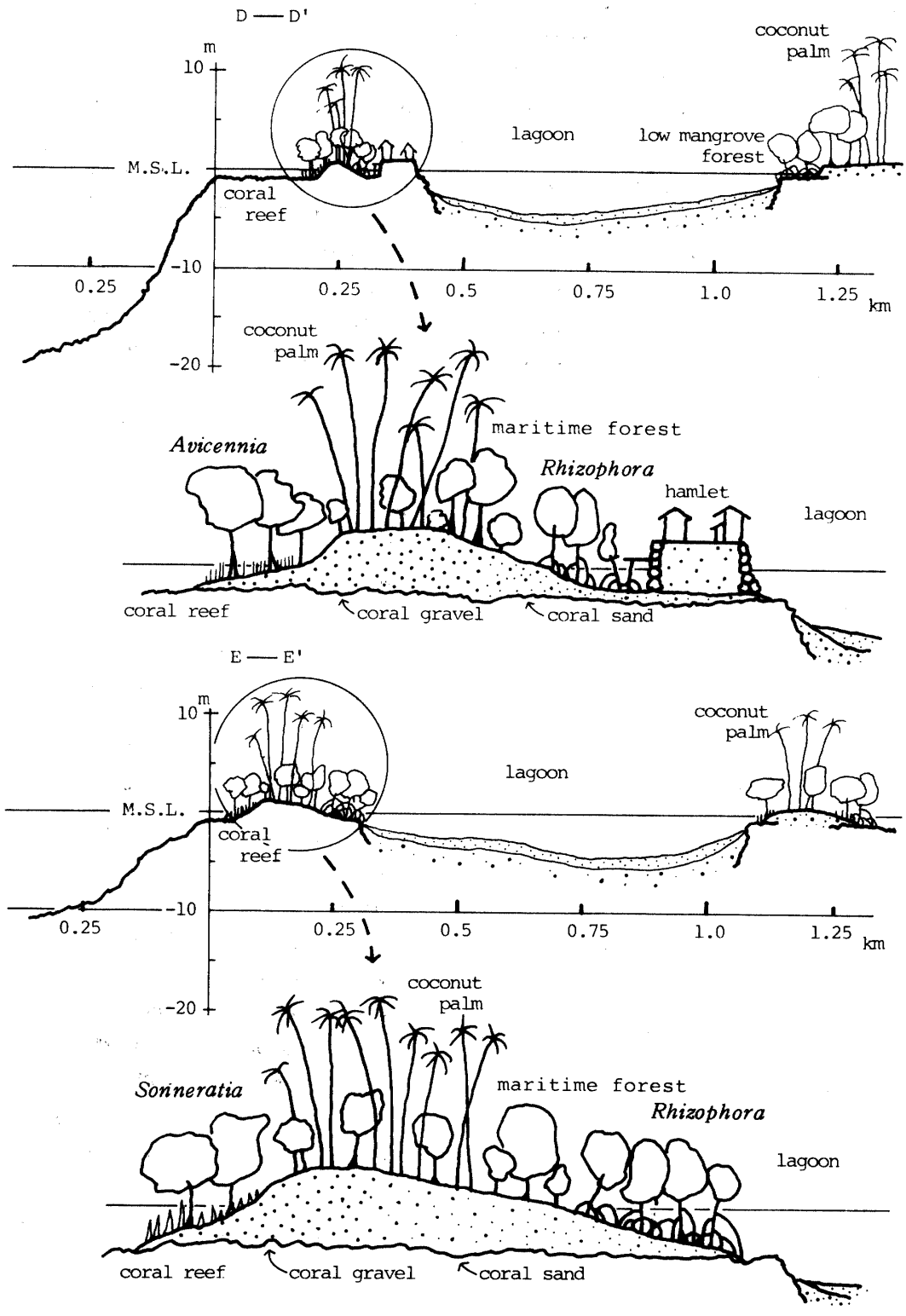


Fig. 3 — (b) Profiles of lines in Fig. 2

mon wave more frequently and inner, coral gravel by relatively large wave occasionally are transported in these mangrove forests. It will be concerned closely with that wave entered into the tangle root system of *Rhizophora* spp. is subsided rapidly. The level of the upper surface of those debris below the sea surface and the ground of islands ranged southern shows a tendency to increase gradually height as they go southern. It can be considered that there is more influence of uplift than the sedimentation accelerated by the root system of mangrove. Many islands in the Pacific are in the subsidence stage but the Solomon Islands is in the uplift stage. Coral reefs have been uplifted and now form a series of terraces clearly seen at Cape Hartig and Cape Zelee on Maramasike as shown in Fig. 4. The islands of Dai and Maana'oba also consist entirely of uplifted coral but they are lower than the Maramasike terraces and do not show signs of several stages of uplift.[3] This is the main cause for the partial distribution of islands in the Langa langa Lagoon and forming the outer edges of the lagoons of west and south-west Malaita.

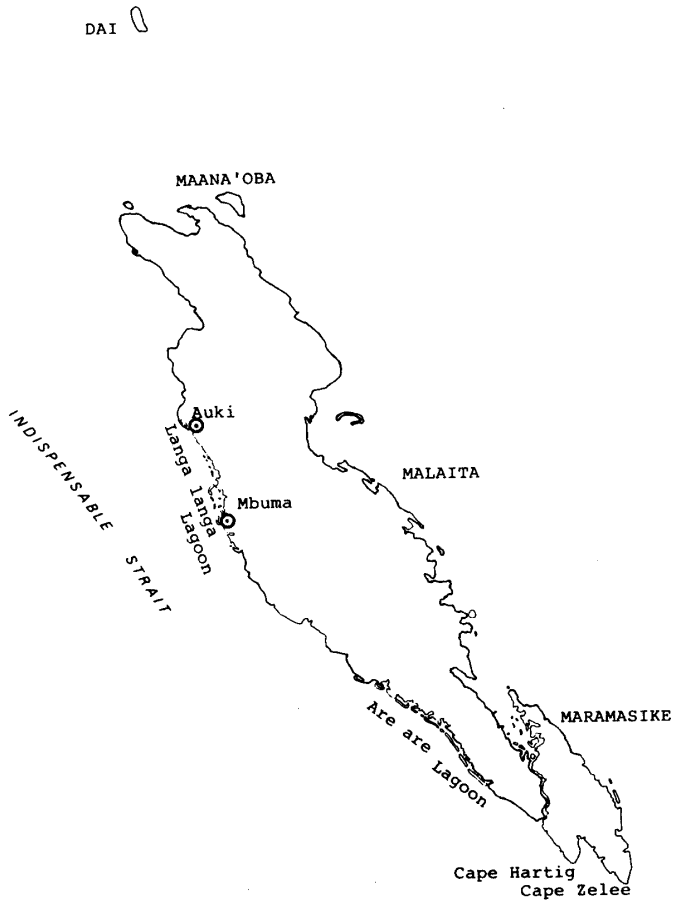


Fig. 4 Outline of the Malaita Islands

The author considered that there are some relationships between human-life here and the chain of islands and mangrove forests on coral reefs described above. As the wave to surge upon from open sea is crashed at front of coral reef then blocked by islands or subsided by the root system of mangrove, a calm surface occures in the lagoon. Any hamlet was not found between Auki and river mouth of Laulana River but contrastively in southern lagoon there were many hamlets in the coast of Malaita mainisland and in the inside of islands. Fig.5 shows well this state. The existance of alluvial plain and the fertility of soil is given as causes of such contrast distribution of hamlets, and furthermore it will be an important cause that a calm surface is suited for traffic and transport by boats and canoes really come and go among Auki, Mbuma and many hamlets, the mangrove forest is useful for the human-life from such point of view.

The possible ways was discussed for practical use of this function stemmed in the characteristics of distribution of prop root system. [6] As the seedling of mangrove is not able to strike its root on the coral reef which is little deeper and is surged from open sea, the establishment of mangrvoe forest is very

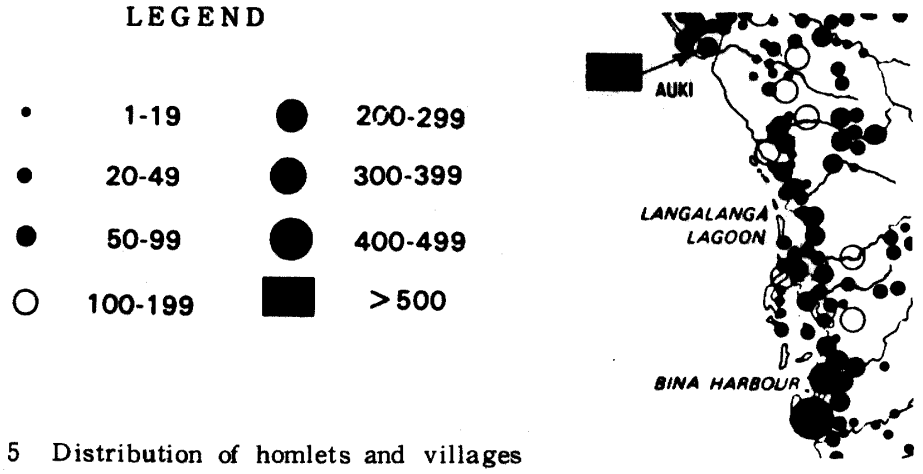


Fig. 5 Distribution of homlets and villages

difficult. If it is realized near Auki, the usefulness and safety of this lagoon for transport will increase.

One method called plant rafts method, was suggested according to the above discussions. An example of plant raft is shown in Fig. 6. It is the method to fix plant rafts to the destined place after mangrove on it has grown up to stand against wave in suitalble surroundings as calm inlet. The considerations on composition and quantity of fertilizer have to be required for reducing the cultivation period. It is fixed by anchor or by root in compliance with depth and the conditions of bed. Two examples might be applied are shown in Fig. 6 and Fig. 7. For the practical applications of this method, there are many problems, for example, structure and intensity of raft, density of pot, fertilizer, anchoring, limit effectiveness against wave and flow, investment and economic effectiveness, which must be investigated in future.

SUMMARY

The mangrove forest in the Langa langa Lagoon, Malaita, the Solomon Islands, was discussed from the point of view of the function to subside wave. According to the discusstions, one method called plant rafts method was suggested and two examples might be applied were shown as figures.

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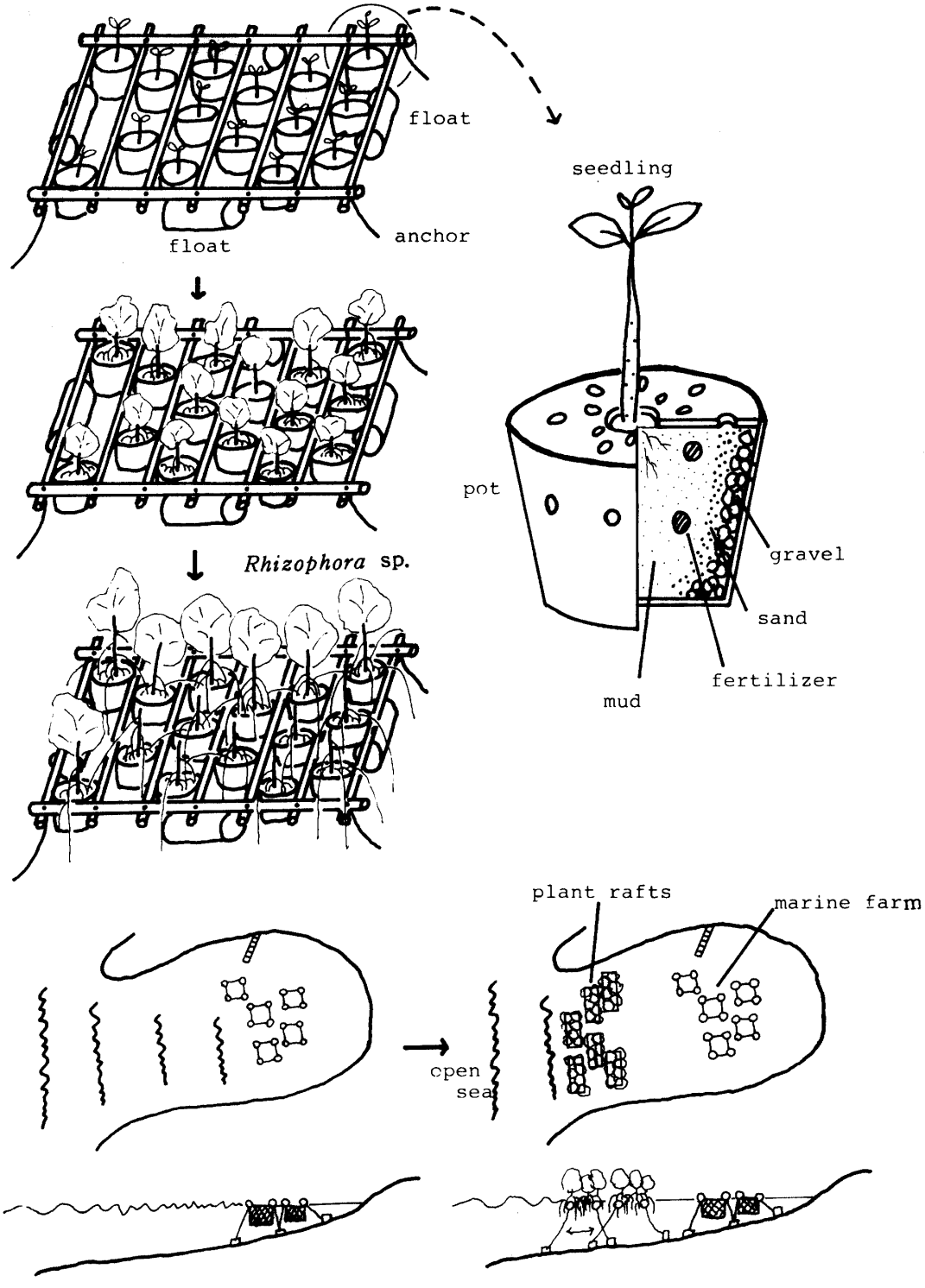

Fig. 6 Example of plant raft and practical application

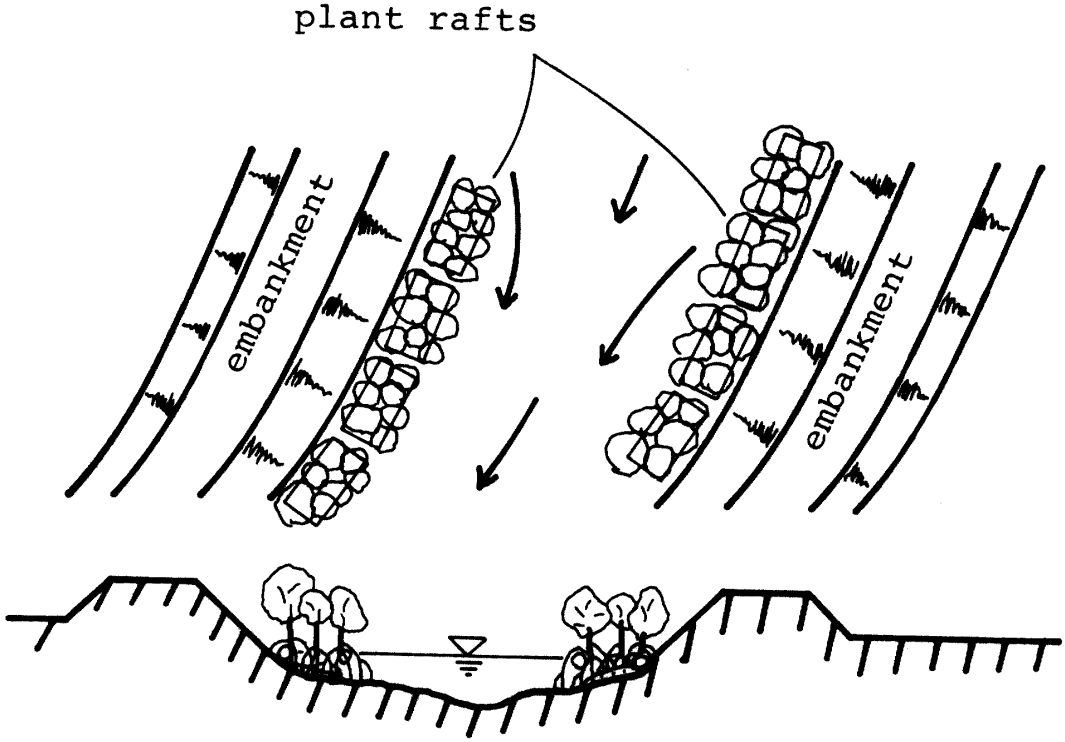

Fig. 7 Example of practical application

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マングローブ林の防災機能に関する研究（II）

ソロモン諸島マライタ島のランガランガラグーンに見られるマングローブ林について

佐　藤　一　紘

要　約

1978年10月，長崎大学水産学部のソロモン諸島学術調査隊の一員として，ソロモン諸島を訪れる機会を得た。諸島の沿岸，汽水域には，旺盛に繁茂するマングローブ林が随所に見られるが，マライタ島中部西岸のランガランガラグーンで見た島列と *Rhizophore* の群落との関連を考察し，その防災的利用の可能性について述べた。

アウキとブマの間，北側三分の一はサンゴ礁のみで，南側三分の二に，島列がマライタ本島と平行して並んでいる。この島列の北側のものは，海図上で島として表現されており，外観は島のように見えるが，サンゴ礁の上に定着したマングローブの群落で，海面下にサンゴ礁に由来する砂礫の堆積をもつが海面上に地面をもたないものである。このような群落内の堆積の上面は，南にゆく程高くなり，海面上に地面をもつようになると他の植生が見られる。

このような状態は，この地域が隆起過程にあることの他に，マングローブ（*Rhizophore* sp.）の根系が波の力を減衰させる機能をもつことと関連すると考えられる。この機能を積極的に利用して，防災的効果を期待する方法を提案した。植生筏法とでも云えるこの方法を実現するためには，今後，筏の構造，肥料等について検討しなければならない。