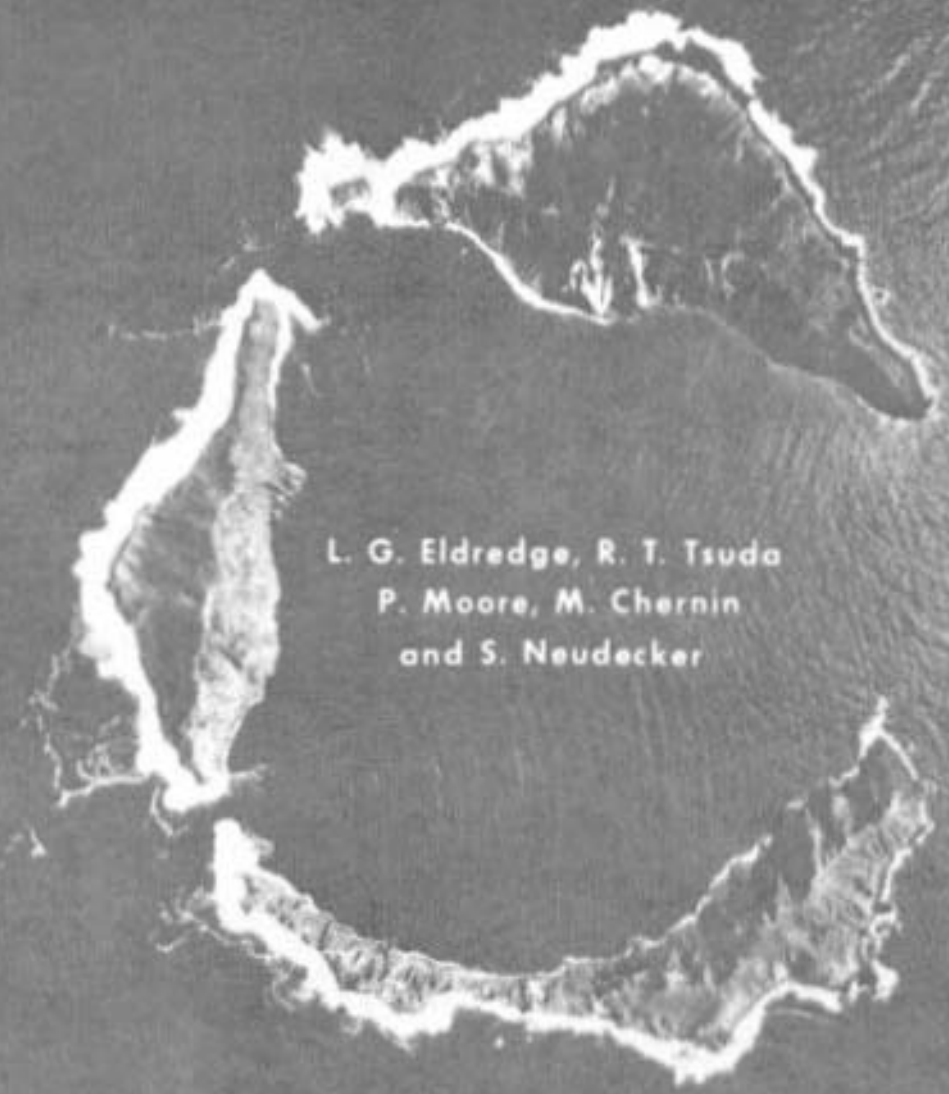
A NATURAL HISTORY OF MAUG, NORTHERN MARIANA ISLANDS



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UNIVERSITY OF GUAM MARINE LABORATORY

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INTRODUCTION

The fifteen islands of the Marianas Chain (Figs. 1 and 2) lie in a nearly straight north-south line between 13° and 20°N. These islands are divided into two somewhat parallel arcs. The outer arc is composed of the southern limestone islands between Guam and Farallon de Medinilla, and the inner arc extends north from Anatahan to Farallon de Pajaros (Uracas). These are the only volcanic islands in Micronesia, and the highest, Agrihan, is also among them. Most have been active in historical times, and at least four are considered very active at present.

Its three islets are located 20° 01' N and 145° 13' E (Fig. 3). Maug is the next to the most northerly island of the Mariana Islands (Fig. 2). The island has been previously known (Bryan, 1971) as:

Bati, Buvi, Eunas Is., Las Monjas, Les Isles, Uracas, Madug, Mahao, Manao, Mang, Mangs, Mao, Mauga, Maui, Mauo, Mayug, Mogo To, Ota, Ota-Mao, Sainte Laurent, San Lorenzo, Tina, Tuna, Tunas Is., Urac, Uraccas, Urakas Is., Urracas, Urracus

The three islets are:

North Island (Kita shima, -to)	227 m (746 ft)
East Island (Higashi shima, -to)	215 m (709 ft)
West Island (Hishi shima, -to)	178 m (591 ft)

Climate

In a military climatological document (CINCPAC-CINCPOA, 1945), the western Pacific was divided into 5° latitude-longitude squares and data is provided for each area. Maug's location at 20° 01' N and 145° 13 E places it in the most distant southwest corner of Area No. 76. The remaining Mariana Islands are in Area No. 89. Since climatological phenomena at Maug are probably more like those of the other southern islands, the data presented here is an interpolation of the two areas:

Mean air temperature	79.5°F (26.4°C)
Precipation	61.7 in (156.7 cm)
No. cyclones, including typhoons[1]	7.2
Typhoons[2]	41.7
Mean ocean surface temperature	80.5°F (26.9°C)
Mean ocean current	13 nautical miles/ day

1 number of all tropical storms which move within 300 miles of the area

2 number of typhoons which passed within 300 miles of the area during a ten-year period.

The direction and number of days for waves in Area No. 89 are as follows:

	J	F	M	A	M	J	J	A	S	O	N	D
N							2/M					
NE												
E												
SE												
S	7/M 2/H											
SW	5/M	7/M 3/H	5/M						3/M	2/M 1/H	5/M 1/H	7/M 3/H
W		6/M 1/H	6/M 1/H	11/M	7/M	8/M 1/H	8/M 1/H	1/M	9/M	8/M 1/H	15/M	8/M 2/H
NW				4/M	2/M	1/M		6/M	3/M	3/M	4/M	

Explanation:

M indicates waves 3-8 ft. high
H indicates waves over 8 ft.
North waves move towards the north.

The direction and number of days for swells in Area No. 89 are as follows:

	J	F	M	A	M	J	J	A	S	O	N	D
N							1/M					
NE												
E												
SE										3/M		
S	4/M	1/M 1/H	3/M									1/M 1/H
SW	5/M 3/H	1/M 5/H	2/M	3/M	4/M				2/M 1/H	2/M 2/H	3/M 2/H	4/M 1/H
W	3/M 1/H	4/M 1/H	2/M 2/H	7/M 1/H	2/M 1/H	3/M 1/H	1/M 2/H	2/M 1/H	5/M 1/H	6/M 2/H	7/M 5/H	6/M 2/H
NW				1/M 1/H		1/M	1/M	3/M 1/H	3/M		2/M	1/H

Seidel (1903) notes a typhoon on 30 August 1858 which directly crossed over Maug and Uracas. Recently, the tropical cyclones affecting Guam have been reviewed (Holliday, 1975). On a map delineating the mean annual number of typhoons traversing 5° latitude-longitude, Maug is located at a line near the border between one and two typhoons a year. Extrapolating from the tracks of storms of greater than 50 knots which have affected Guam, the following typhoons have passed either over or very close to Maug.

Emma, October 1962
Jean, April 1968
Irma, October 1968
Ida, October 1969
Amy, May 1971

Preservation

At the Pacific Science Association's Eleventh Pacific Science Congress in Tokyo in 1966, an international program for island conservation was begun (Holdgate and Nicholson, 1967). Among other tasks designated by a Congress Resolution (No. 4.3) was a proposal to convene a technical meeting at Koror, Palau, in 1968. This meeting was a cooperative undertaking involving the Pacific Science Association, the International Biological Programme (IBP), and the International Union for the Conservation of Nature and Natural Resources (IUCN). A "Technical Meeting on Conservation of Pacific Islands" was held at Koror, Palau and Guam in November 1968. At that time four Marianas "islands for science" were designated -- Farallon de Medinilla, Guguan, Maug, and Uracas (Nicholson and Eldredge, 1969). The first island is and has been a bombing range and can no longer be considered (Anon., 1974).

In the Northern Mariana Islands Constitution (Article XIV, Natural Resources), marine resources (Section 1) and uninhabited islands (Section 2) are detailed. Maug (and Sariguan) are listed to be "maintained as uninhabited places and used only for the preservation of bird, fish, wildlife, and plant species."

Sir Peter Scott further recommended preservation of Maug following his visit aboard the Lindblad Explorer in August 1976.

Figure 1. General location map of Pacific Ocean.

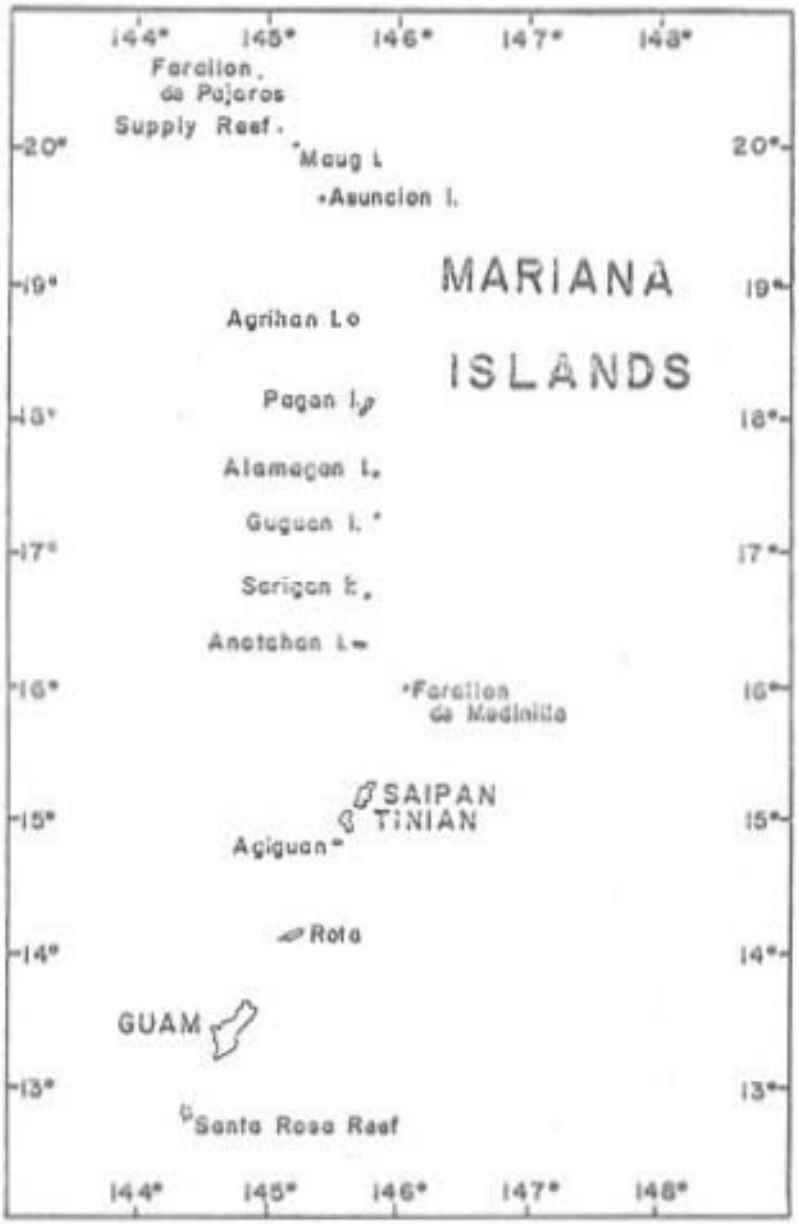

Figure 2. Mariana Islands.

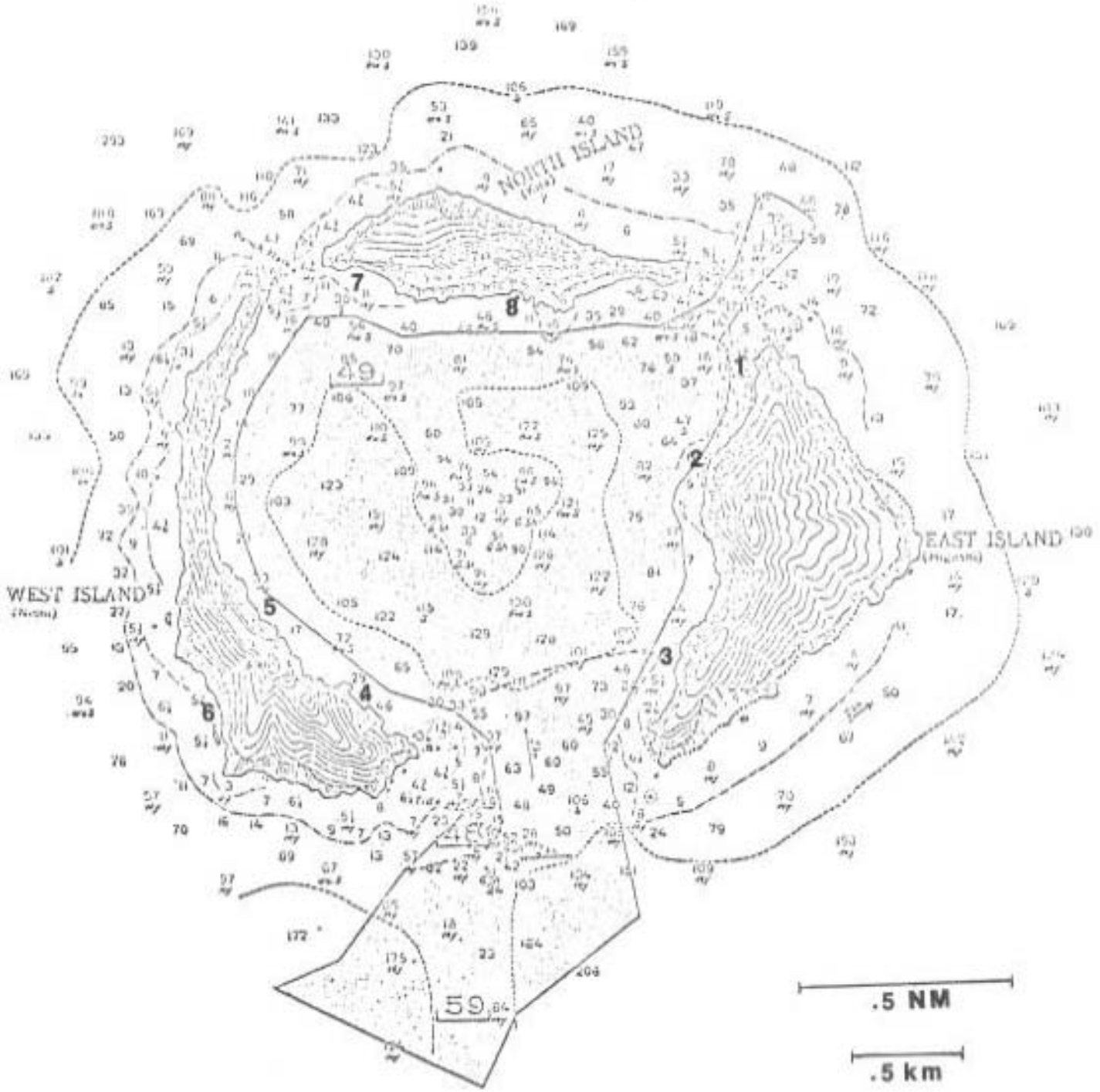

Figure 3. Maug. Note location of field stations for coral and algal observations. Soundings in fathoms, elevation in feet. (Department of Navy, Oceanographic Office, Chart No. 81092.)

DISCOVERY AND EXPLORATION

Maug was discovered on 17 August 1669 by Diego Luis de Sanvitores who named the island San Lorenzo. He "converted and baptized" the natives and left a secular assistant to care for the needs of the people and the church which was built there (Garcia, 1683). In 1695 the natives of "Gani" (the name for the eight islands to the north) were collectively taken to Saipan (Le Gobien, 1701). Anchored off Asuncion in 1786, La Perouse (1797) sighted Maug and mapped the island. His bearings were apparently wrong, for he placed Maug (called Mang) and Uracas south southwest of Asuncion. In 1862 the Spanish chart aligned the three islands. At the same time the English chart placed Maug (Mang) south southwest of Asuncion and Uracas north northwest, using both Uracas and Mangs as names for the latter. Don Eugenio Sanchez y Zayas sailed throughout the islands with the Governor of the Marianas in early 1866 aboard the "Narvaez." He described Maug, called Uracas Isles by him, as being a "miserable desolate group, without a tree, without a blade of grass, or even a run of fresh water." (Sanchez ye Zayas, 1866, p. 469). He searched for La Perouse's Mang and concluded that the charts were in error and thus corrected them. In the early 1870's Governor Don Luis de Ibanez y Garcia visited the islands and wrote a history and description of them (Ibanez, 1886).

During this period the island was referred to as Maug, which may have been read Mang, hence the name Monjas. The old inhabitants apparently called the island Madug or Tunas.

In 1899 the administration of the islands changed from that of Spanish to German.

In May 1901, Governor G. Fritz, Marianas administrator, visited Maug. He described the general geology and vegetation of the island and described the large basaltic dikes. He climbed to the top of East Island, noting a cotton blooming in a rain-made channel. Large groves of coconuts were recorded. Ada, his guide and Pagan resident, estimated a possible annual yield of 15 tons of copra. Fritz looked for remains of inhabitants but found none (Fritz, 1902).

Fritz's (1902) work served as a basis of most future descriptions of the island. His material is quoted in Prowazek's (1913) detailed description of the German Marianas.

In 1914 the islands became part of the Japanese South Sea under a mandate of the League of Nations.

A number of Japanese scientists visited the northern islands. Tayama (1936) visited these islands in 1922 as part of a magnetic

survey party of the Hydrographical Department. He described the general and submarine topography, pointing out that all three islets together form a single volcano he called Maug Volcano. He also briefly discussed the general geographical features of Maug. He concluded with a short description of the coral reefs, describing them as being on the "younger" side. Using Tayama's material, Yoshii (1936) described the microscopic structure of noncalcareous rocks from Maug. Under the auspices of the Imperial Academy of Japan, H. Tanakadate sailed through the islands in 1936. His brief description of Maug discussed the form of the volcano and composition of the rock (Tanakadate, 1940). A weather station was established at the summit of East Island in 1939, and a fish processing plant was at the shore of East Island.

After 1944 the islands of the Marianas were administered by the United States as a United Nations Trust Territory. Several field studies were carried out under the auspices of the Pacific Vegetation Project at Pagan. Little or no work was conducted at Maug.

In February 1971, R. S. Jones, R. H. Randall, R. Struck, and H. Kami of the University of Guam and Guam's Fish and Wildlife Division travelled to Maug aboard the "U.S.N. Grasp." They collected fish and corals, as well as some algae and invertebrates. The results of their study are included in this report.

On their third cruise through the northern islands during July 1972, P. J. Hoff, C. Carlson, J. Long, M. V. C. Falanruw, D. Smith, and P. Rankin visited Maug aboard the "Wanderer" skippered by R. Hervin. The group collected terrestrial plants, algae, and invertebrates (mainly opisthobranch mollusks). The plants have been reported by Fosberg, Falanruw, and Sachet (1975). Twenty-four opisthobranch species were collected by P. J. Hoff and C. Carlson and are listed in this report. Additional records of the megapode have been published (Falanruw, 1975).

The National Marine Fisheries Service R/V "Townsend Cromwell" cruised throughout the islands in April and October 1971 and took depth and temperature measurements. These results are yet unpublished.

A general account of all the islands, including Maug, was published by Lehne and Gabler (1972).

In January 1975 the University of Guam Marine Laboratory held the first of two trips throughout the entire chain aboard the schooner "New World" skippered by A. Mercereau and owned by the late G. Kiskaddon of San Francisco. The major objective was a broad-based marine survey. This group included L. G. Eldredge and nine University students. During July of the same

year, the "New World" sailed again throughout the islands, stopping both times at Maug. This time L. G. Eldredge was joined by S. Amesbury of the University of Guam, E. A. Kay and C. Lamoureux of the University of Hawaii, and M. V. C. Falanruw of the Yap Institute of Natural Sciences, as well as five students. The second trip included some detailed terrestrial investigations. The marine algae have been reported by Tsuda and Tobias (1977a, 1977b), and additions to the vascular plants by Fosberg, Falanruw, and Sachet (1977). Popular accounts of these trips have appeared (Eldredge, 1975; Ronck, 1975a, 1975b, 1975c).

In August 1976 the "Lindblad Explorer" with Sir Peter Scott and R. and V. Taylor aboard spent one day at Maug. In a report to the Resident Commissioner (Lindblad Explorer, 1976), they sight recorded 113 species of reef fish, sixteen bird species, and recommended that the island be protected.

At the request of the Trust Territory of the Pacific Islands Government, the Japan Marine Fishery Research Centre conducted a pole-and-line fishery survey (Japan Marine Fishery Research Centre, 1976) aboard the No. 20 "Akitsu-Maru." A water-temperature profile was made east of Maug to a depth of 250 m, showing a temperature of 17°-18°C. Additionally, a bottom-hand-line fishery survey was carried by the Micronesian Coordinated Development Co., Ltd., in February 1976 to examine the deeper water fishery. The survey carried out aboard the "Daikatsu-Maru," visited Maug and reported several species of fish caught, totaling 4400 lbs. They concluded that Maug is a good fishing area (Micronesian Coordinated Development Co., Ltd., 1976).

The "Lindblad Explorer" visited Maug a second time during August 1977 and reported observations to the Resident Commissioner.

Between 23-26 November 1977 five biologist from Guam (R. T. Tsuda, L. G. Eldrege, P. Moore, M. Chernin, and S. Neudecker) spent four days at Maug aboard the "Eiriyo Maru No. 3" carrying out the on-site-environmental survey upon which much of the following report is based.

Virtually no studies have been made on the terrestrial vertebrates and gastropods, as well as the insects. No oceanographic studies are known from the lagoon or the immediate vicinity, and no archaeological investigations have been carried out.

MARINE ENVIRONMENT

PHYSIOGRAPHY AND CORALS

The previous surveys of corals at Maug were made by R. H. Randall on February 10-11, 1971 aboard the "USN Grasp" and by S. Moras aboard the "New World" during January 1975. The specimens collected are deposited in the reference collection of the University of Guam Marine Laboratory. The primary objective of the recent coral survey abroad the "Eiriyo Maru No. 3" was to describe the diversity and relative abundance of living reef corals inside the Maug Crater Lagoon. The entire subtidal slope to -10 m of depth was inventoried by towing reconnaissance and skin diving. Estimates of the relative coral genera abundance, and species abundance when possible, were determined for each coral covered area according to Randall's scale (in Amesbury et al., 1976) where: dominant (D) = the predominant coral within a zone, abundant (A) = a species generally distributed throughout a reef zone, common (C) = a species generally present but with a patchy distribution within the zone, and rare (R) = a species represented by only one or two occurrences within a reef zone.

Approximately 20 hours of field observations were devoted to the semi-quantitative appraisal of coral communities. In addition to the lagoon-wide survey, the seaward side of West Island was also surveyed for living coral coverage. Heavy surf prevented reconnaissance of the seaward sides of North and East Island.

Only a few species of the protean genera Acropora, Pocillopora, Porites and Montipora were recognized in the field. Taxonomic problems are paramount in these genera and therefore species and their intergrading growth forms were not separated during field observations. Most of the other genera were classified to the specific level in situ. Specimens of the various coral species encountered were collected for later taxonomic verification and were subsequently deposited in the University of Guam Marine Laboratory Museum. Laboratory determinations were made with E. H. Randall's help and according to taxonomic references by Wells (1954, 1956).

Description of Corals at Each Site

No true coral reef development exists inside the crater lagoon. See Fig. 3 for site locations. The towing survey revealed a few localized coral communities which are described below. The most developed coral area was that of Site 5 off West Island. Very little coral coverage was found along the lagoon side of North Island and no coral communities were found there. Since this survey was limited to skin diving, further observation by scuba diving would probably increase the total coral diversity.

Site 1 - This site was located at the northern end of East Island. Localized coral communities were growing on large basaltic boulders. Living corals were growing from near the shore and down the lagoon slope to the sand bottom at a depth of -10 m. Millepora platyphylla was the predominant coral and species of Pocillopora were abundant. Acropora humilis, A. hystrix, A. irregularis and other Acropora species were common along with Favia species and Goniastrea retiformis. Acanthastrea echinata, Leptastrea purpurea, Astreopora spp., Pavona spp., Montipora spp. and Galaxea fascicularis were encountered occasionally.

Site 2 - This site was located near the mid-portion of East Island, and was characterized by basalt boulders which gradually slopes to a sandy bottom. No corals were seen in this area.

Site 3 - This site was located near the southern end of East Island. This coral community was predominated by large heads of Porites lutea and colonies of Millepora platyphylla. Goniastrea retiformis was abundant and Pocillopora species were common. Acropora, Alveopora, Astreopora, Favia, Montipora, Pavona, and Turbinaria were found occasionally. Coral colonies extended out a few meters from shore to a submarine cliff (-15 m) about 70 m from shore.

Site 4 - This site was located near the southern end of West Island. Only scattered colonies were observed and coverage was low. Many basaltic boulders covered the substratum of a narrow submarine terrace (10 m wide) and some were overgrown with Millepora platyphylla and Porites lutea. Goniastrea retiformis, Favia, Acropora, and Astreopora were found occasionally.

Site 5 - This study site was a few hundred meters north of Site 4 and supported the most diverse and abundant coral development in the crater lagoon. Huge ramose-columnar colonies of Acropora irregularis predominated the submarine terrace in shallow waters (-1 to -3 m) near shore. The terrace-slope was about 50 m wide at -10 m. Millepora platyphylla and Goniastrea species predominated the lagoon slope and massive Porites lutea was locally abundant. Common corals included Goniopora, Acropora, Pocillopora and Favia. Species encountered occasionally included Euphyllia glabrescens, Galaxea fascicularis, Leptastrea purpurea, Leptoria phyrigia, Psammocora, Pavona, Goniopora, Alveopora, Montipora, Millepora dichotoma, and Stylocoeniella armata.

Site 6 - This well developed fringing reef was located on the seaward side of West Island and extends along the southern half of the island. Coral coverage was high and the species composition diverse. Corals observed included massive Porites, Millepora, several species of Acropora, Pocillopora, Favia, Favites, Porites and Pavona. Also seen were Lobophyllia, Diploastrea heliopora, Leptoria, Acanthastrea, Stylocoeniella, Goniopora, Galaxea, and Heliopora coerulea.

Site 7 - This site was located at the western end of North Island. Coral coverage was very low at this site. Occasionally colonies of Millepora platyphylla, Pocillopora and Astreopora were found on large boulders of basalt.

Site 8 - This site was located at the mid-portion of North Island, and was characterized by a narrow bench about 20 m wide comprised of basalt boulders. The bench ended at a sheer drop-off (-10 m) which characterized much of the coastline. Millepora platyphylla formed massive structures near shore.

Enumeration of Corals

A list of all coral species found inside the lagoon is presented in Table 1. The species names were based on R. H. Randall's determinations and corals identified on this recent trip. Thirty-one genera and 74 species of scleractinian corals are included; two genera and four species of non-scleractinians were also found.

When the Maug crater lagoon is considered as a whole, the coral coverage on its lagoon slopes is low. No actively accreting coral reefs occur in the lagoon and the areas with the highest surface coverage (i.e., Site 5) were considered to be coral communities. Sediments of volcanic origin and basaltic boulder were predominant along most of the crater's submarine slope. The perpetual raining down of sediments and rocks are principally responsible for the lack of coral coverage inside the lagoon.

Table 1. Checklist of corals collected or observed during the "USN Grasp" trip and the "Eiriyo Maru No. 3" trip. Non-scleractinian corals are preceded by an asterisk.

Astrocoeniidae
- Stylocoeniella armata (Ehrenberg)
- S. quentheri (Basset-Smith)

Thamnasteriidae
- Psammocora nierstraszi van der Horst
- P. (S.) togianensis Umgrove

Pocilloporidae
- Pocillopora elegans Dana
- P. meandrina Verrill
- P. setchelli Hoffmeister
- P. verrucosa (Ellis & Solander)
- Stylophora mordax (Dana)

Acroporidae
- Acropora abrotanoides (Lamarck)
- A. humilis (Dana)
- A. hystrix (Dana)
- A. irregularis (Brook)
- A. kenti (Brook)
- A. murrayensis Vaughan
- A. nasuta (Dana)
- A. palifera (Lamarck)
- A. rayneri (Brook)
- A. squarrosa (Ehrenberg)
- A. surculosa (Dana)
- A. wardi Verrill
- Astreopora myriophthalma (Lamarck)
- Astreopora sp. 1
- Astreopora sp. 2
- Montipora sp. 1
- Montipora sp. 2
- Montipora sp. 3
- Montipora sp. 4
- Montipora sp. 5

Agariciidae
- Pavona clavus Dana
- P. varians Verrill
- Pavona sp. 1
- Pavona sp. 2
- Pavona sp. 3
- Pavona (P.) pollicata Wells
- Leptoseris sp. 1
- Leptoseris sp. 2

Table 1. continued.

Fungiidae
- Fungia scutaria Lamarck

Poritidae
- Alveopora sp. 1
- Alveopora sp. 2
- Goniopora sp. 1
- Goniopora sp. 2
- Porites lobata Dana
- P. lutea Milne-Edwards & Haime
- Porites (S.) sp. 1
- Porites (S.) sp. 2

Faviidae
- Cyphastrea sp.
- Echinopora lamellosa (Esper)
- Favia pallida Dana
- F. speciosa (Dana)
- Favia sp. 1
- Favia sp. 2
- Favia sp. 3
- Favites sp. 1
- Favites sp. 2
- Favites sp. 3
- Diploastrea heliopora (Lamarck) [outside only]
- Goniastrea retiformis (Lamarck)
- Goniastrea sp. 1
- Goniastrea sp. 2
- Leptastrea purpurea (Dana)
- Leptastrea sp.
- Leptoria phrygia (Ellis & Solander)
- Montastrea curta (Dana)
- Platygyra dadaelea (Ellis & Solander)
- P. pini Chevalier
- Platygyra sp.

Rhizangiidae
- Culcia rubeola (Quoy & Gaimard)

Oculinidae
- Galaxea fascicularis (Linnaeus)

Mussidae
- Acanthastrea echinata (Dana)
- Lobophyllia sp. [outside only]

Pectiniidae
- Echinophyllia sp.

Table 1. continued.

Caryophyllidae
Euphyllia glabrescens Chamisso & Eyserhardt
Plerogyra sinuosa (Dana)
Dendrophylliidae
Tubastrea aurea (Quoy & Gaimard)
Turbinaria sp. 1
Turbinaria sp. 2
Heliporidae
**Heliopora coerulea* (Pallas)
Milleporidae
**Millepora dichotoma* Forskaal
**M. exesa* Forskaal
**M. platyphylla* Hemprich & Eherenberg

MARINE BENTHIC ALGAE

Past published records of marine benthic algae from Maug can be found in two papers (Tsuda and Tobias, 1977a, 1977b). The 48 species listed in these papers are based on algae collected by R. H. Randall ("USN Grasp", February 10, 1971), M. V. C. Falanruw ("Wanderer", July 5, 1972), W. J. Tobias ("New World", January 19, 1975), R. Rechebei and L. G. Eldredge ("New World", July 9, 1975). During the recent trip to Maug aboard the "Eiriyo Maru No. 3", the major objective was to obtain quantitative data on the algal communities.

The algal communities (Table 2) in the lagoon crater are characterized by low lying turfs comprised predominantly of a mixture of the red algae Gelidiopsis intricata, Tolypiocladia glomerulata, Jania capillacea, and Polysiphonia sp., as well as the prostrate brown alga Lobophora variegata. These algae cover 75-95 percent of the basalt boulders and pavements. The algal cover on the dead calcareous substratum in the coral communities (Site 1 and 5) may be as high as 100% cover in localized areas. Aside from Asparagopsis taxiformis which is not eaten by fishes because of its high iodine content, all algal species were less than 5 cm high.

The major reason for the lack of macroalgae in the lagoon crater is the abundance of herbivorous fish which were seen constantly feeding on the algal turfs. Analyses of the stomach contents (Table 3) of the two most abundant fish species at Site 7 (western end of North Island) revealed preference for different algal species. About 95 percent of the algae eaten by the browser Kyphosus cinerascens was the red alga Tolypiocladia glomerulata which covered about 80 percent of the basalt boulders in the area. On the other hand, the grazer Acanthurus leucopareius did not feed on this dominant alga in the area but preferred three other species (Gelidiopsis intricata, Jania capillacea, and Caulerpa ambigua). These three species comprised about 80 percent of the food items in the stomach. Basalt grains were found in the stomach of A. leucopareius but not in K. cinerascens.

Twelve additional species of marine benthic algae were collected during this recent trip, thus, raising the total number of species now known from Maug to 60. The list (Table 4) consists of the following species-Cyanophyta (4 spp.), Chlorophyta (25 spp.), Phaeophyta (11 spp.), and Rhodophyta (20 spp.). With the exception of one species, all of the algae have been recorded from either Guam or other islands in Micronesia. The exception is the red alga Laurencia succisa which must be considered rare on Maug since it was not found in the recent collections. The brown alga Homoeostrichus flabellatus has been collected only once in

Micronesia and is a specimen dredged off Guam (Tsuda, 1972a) in water 70-80 m deep; this alga is abundant at Site 2 off East Island. A collection of the brown alga Stypopodium hawaiiensis (=Zonaria hawaiiensis) on East and North Islands represents the first record for the Marianas. It is, however, known from Truk (Tsuda, 1972b) and grows luxuriantly in the Hawaiian Islands (Doty and Newhouse, 1966).

The 60 species of marine benthic algae reported from Maug represent about 30 percent of those species known from Guam. It is highly unlikely that further collections will add substantially to this listing, unless collections are concentrated off the seaward coast of East and North Islands. Only two (H. discoidea and H. opuntia) of the 11 species of Halimeda which occur on Guam were found on Maug. Interestingly, these species are two of the three species of Halimeda known from Hawaii which is located further east but at approximately the same latitude (20-21°N). The absence, thus far, of seagrasses, Avrainvillea, and the larger species of Udotea also seems to strengthen the idea of a closer similarity of the Maug marine flora to Hawaii than to the southern Mariana Islands.

Table 2. Algal dominance (Sites 1-4, 6-8) and percent cover (Site 5) at each of the eight sites surveyed. Abundant (A) = 50% cover, Common (C) = 5-50% cover, Rare (R) = <5% cover. See coral section for description of each of the eight sites and Fig. 3.

	East I.			West I.			North I.	
	1	2	3	4	5	6	7	8
Species					(n=10)			
Cyanophyta								
Calothrix crustacea			C				R	
Microcoleus lyngbyaceus					1%	C		
Schizothrix mexicana							R	
Chlorophyta								
Acetabularia moebii						R	R	
Boodlea composita					11%			
Bornetella oligospora							R	
Bryopsis pennata					11%		R	
Caulerpa filicoides	R						R	
Caulerpa racemosa	R			C				
Caulerpa serrulata							R	
Caulerpa taxifolia	R							
Codium edule			C					
Dictyosphaeria cavernosa	A	C						
Halimeda discoidea	C							
Halimeda opuntia							C	
Neomeris annulata							C	
Pseudochlorodesmis furcellata							R	
Udotea javensis	C							
Valonia utricularis		C					R	
Phaeophyta								
Dictyota bartayresii	R						C	
Ectocarpus breviarticulatus					A		A	
Homoeostrichus flabellatus	A							
Lobophora variegata	C	C	C	C	14%	C		
Sphacelaria sp.	R					C		
Stypopodium hawaiiensis		C						C
Rhodophyta								
Amphiroa fragilissima							R	
Asparagopsis taxiformis	C							
Ceramium cf. mazatlanense						C		
Gelidiopsis intricata			A		60%	C	C	
Hypnea esperi	C					C		
Jania capillacea	C	C	C	C	10%	C	C	
Laurencia tropica	R							
Liagora sp.			R					
Polysiphonia sp.			C	C		C	C	
Tolypiocladia glomerulata	C					C	C	
"coralline algae"					3%			

Table 3. Comparison of food habits of the reef fishes Kyphosus cinerascens (n=5, $\bar{X}$ total length=256 mm, S.D.=21 mm) and Acanthurus leucopareius (n=5, $\bar{X}$ total length=177 mm, S.D.=23 mm) with algal flora in the area. West end of North Island, November 24, 1977.

Species	Substratum	Kyphosus cinerascens	Acanthurus leucopareius
Cyanophyta			
Calothrix crustacea	X	X	
Schizothrix mexicana	X		
Chlorophyta			
Acetabularia moebii	X	X	X
Bornetella oligospora	X		
Bryopsis pennata	X		
Caulerpa ambigua		X	X
Caulerpa filicoides	X		
Caulerpa serrulata	X		
Dictyosphaeria cavernosa		X	X
Halimeda opuntia	X		
Neomeris annulata	X		
Pseudochlorodesmis furcellata	X		
Valonia utricularis	X		X
Phaeophyta			
Dictyota bartayresii	X		
* Feldmannia indica		X	
Lobophora variegata		X	
Rhodophyta			
Amphiroa fragilissima	X		
Gelidiopsis intricata	X	X	X
Jania capillacea	X		X
Laurencia sp.		X	X
Polysiphonia sp.	X	X	X
Tolypiocladia glomerulata	X	X	X

Table 4. Checklist of marine benthic algal species reported from Maug. Based on listings by Tsuda and Tobias (1977a, 1977b) and recent unpublished collections made by R. T. Tsuda aboard the "Eiriyo Maru No. 3" during November 23-25, 1977. New unpublished records are preceded by asterisks.

Division CYANOPHYTA (blue-green algae)

Order Oscillatoriales
- Calothrix crustacea Schousboe & Thuret
- Microcoleus lyngbyaceus (Kutz.) Crouan
- Schizothrix calcicola (Ag.) Gomont
- Schizothrix mexicana Gomont

Division CHLOROPHYTA (green algae)

Order Siphonales
- *Bryopsis pennata Lamx.
- *Caulerpa ambigua Okamura
- Caulerpa filicoides Yamada
- Caulerpa racemosa (Forssk.) J. Ag.
- Caulerpa serrulata (Forssk.) J. Ag.
- Caulerpa taxifolia (Vahl) C. Ag.
- Caulerpa vickersiae Boerg.
- Caulerpa webbiana Montagne
- *Codium edule Silva
- Halimeda discoidea Decaisne
- Halimeda opuntia (L.) Lamx.
- *Pseudochlorodesmis furcellata (Zanard.) Boerg.
- Tydemannia expeditionis W. v. Bosse
- *Udotea javensis (Mont.) A. & E. S. Gepp

Order Siphonocladales
- Boergesenia forbesii (Harv.) Feldmann
- Boodlea composita (Harv.) Brand
- Cladophoropsis membranacea (Ag.) Boerg.
- Dictyosphaeria cavernosa (Forssk.) Boerg.
- Valoria aegagropila C. Ag.
- Valoria utricularis (Roth) C. Ag.
- Valoria ventricosa J. Ag.

Order Dasycladales
- Acetabularia exigua Solms-Laubach
- Acetabularia moebii Solms-Laubach
- Bornetella oligospora Solms-Laubach
- Neomeris annulata Dickie

Table 4. continued.

Division PHAEOPHYTA (brown algae)

Order Ectocarpales
- Ectocarpus breviarticulatus J. Ag.
- *Feldmannia indica (Sonder) Womersley & Bailey

Order Sphacelariales
- *Sphacelaria sp. (propagula absent)

Order Dictyotales
- Dictyopteris repens (Okamura) Boerg.
- Dictyota bartayresii Lamx.
- *Homoeostrichus flabellatus Okamura
- Lobophora variegata (Lamx.) Womersley
- Padina jonesii Tsuda
- *Stypopodium hawaiiensis (Doty & Newhouse) Abbot:

Order Fucales
- Sargassum cristaefolium C. Ag.
- Turbinaria ornata (Turn.) J. Ag.

Division RHODOPHYTA (red algae)

Order Nemaliales
- Asparagopsis taxiformis (Delile) Collins & Hervey
- Actinotrichia fragilis (Forssk.) Boerg.
- Galaxaura filamentosa Chou
- Gelidium pusillum (Stackh.) Le Jolis
- *Liagora sp.
- Wurdemannia miniata (Lmk. & DC) Feldmann & Hamel

Order Cryptonemiales
- Amphiroa fragilissima (L.) Lamx.
- Jania capillacea Harvey
- Jania decussato-dichotoma (Yendo) Yendo
- Jania tenella Kutz.

Order Gigartinales
- Gelidiopsis intricata (Ag.) Vickers
- *Hypnea esperi Bory

Order Rhodymeniales
- Botryocladia skottsbergii (Boerg.) Levring

Order Ceramiales
- Ceramium cf. mazatlanense Dawson
- Hypoglossum attenuatum Gardner
- Laurencia succisa Cribb
- Laurencia tropica Yamada
- Tolypiocladia gomerulata (Ag.) Schmitz
- *Polysiphonia sp.
- Wrangelia anastomosans Yamada

MARINE INVERTEBRATES

The marine invertebrate fauna of Maug resembles a typical Indo-West Pacific coastal area. A number of corals are found (see section on physiography and corals), as well as a number of coral-associated animals. Generally, the marine fauna is similar to that of Guam and the southern islands. Interestingly, two gastropod (abalone) species (Haliotis spp.) are found at Maug which are unknown south of Anatahan. The large carnivorous gastropod, Purpura persica, is common in the intertidal zone. Individuals appear to have a preference for a volcanic substrate. There are no verified records from Guam. P. persica is commonly found at all the islands north of Anatahan. The short-spined sea urchin Colobocentrotus mertensi is also commonly found on intertidal boulders, having an abundance of as many as twenty individuals per quarter meter square (20/0.25 m^2) at the north end of East Island and twenty-four and twenty-six per quarter meter square (24-26/0.25 m^2) at the west end of North Island.

The land hermit crab Coenobita perlata was the most common shore form. Six to ten individuals were seen around boulders at the shore, and ten to fifteen could be observed in a distance of three meters. Each crab was associated with a Turbo shell. This hermit crab species is rarely seen at Guam.

Noteworthy, among the species identified are the twenty-four species of opisthobranchs collected by C. Carlson and P. J. Heff at depths to 10 m in four hours in July 1972. This represents only part of an apparently rich opisthobranch fauna.

Sixty-four species in eighteen families of gastropods are recorded, along with their collection areas. Twenty-one echinoderm species are included. A total of 130 species of marine invertebrates, exclusive of the corals, are reported herein. This total number compares quite favorably with the 171 similar species reported from the Ogasawara and Volcano Islands to the north (Ooishi, 1970). These species are listed in Table 5.

More specimens need to be collected in order to carry out a more meaningful zoogeographical analysis.

Table 5. Checklist of the invertebrates from Maug.
[For the gastropods: Sp=supratidal; IV=intertidal volcanic; IL=intertidal limestone; SbVB=subtidal volcanic boulders; (N)=collected nonliving.]

Cnidaria	
Anthozoa	
Alcyonacea (Identifications by M. Gawel)	
Cladiella sp.	
Lobophytum crebriplicatum Marenzeller	
Sarcophyton sp.	
Sinularia sp.	
Antipatharia	
Cirripathes sp.	
Annelida	
Polychaeta	
unident. spp.	
Mollusca	
Amphineura	
unident sp.	
Gastropoda	
Prosobranchia (Identifications by R. Dickinson)	
Haliotidae	
Haliotis sp. 1	Sp
Haliotis sp. 2	Sp
Patellidae	
Cellana toreuma (Reeve)	Sp, IV
Patella flexuosa Quoy & Gaimard	IV, IL
Patella sp. 4	IL
Patella sp. 8	IV
Patella sp. 9	IV
Trochidae	
Australium petrosum (Martyn)	SbVB
Tectus pyramis (Born)	SbVB
Trochus maculatus Linnaeus	IL, SbVB
Turbinidae	
Astraea rhodostoma (Lamarck)	SbVB
Turbo argytostomus Linnaeus	SbVB
T. petholatus Linnaeus	SbVB(N)
T. setosus Gmelin	IV, SbVB
Neritidae	
Nerita plicata Linnaeus	Sp

Table 5. continued.

Littorinidae	
Echininus cumingi (Philippi)	Sp
Littorina pintado (Wood)	Sp
Nodolittorina pyramidalis (Quoy & Gaimard)	Sp
Architectonicidae	
Heliacus sp.	SbVB
Planaxidae	
Planaxis lineatus (da Costa)	IV
P. niger Quoy & Gaimard	IV
Cerithiidae	
Cerithium aluco (Linnaeus)	SbVB
C. echinatum (Lamarck)	SbVB
Cerithium sp. 4	SbVB
Cypraeidae	
Cypraea arabica Linnaeus	SbVB
C. carneola Linnaeus	IV(N)
C. caputserpentis Linnaeus	IV, SbVB
C. globulus Linnaeus	SbVB
C. isabella Linnaeus	SbVB
C. mauritiana Linnaeus	IV
C. poraria Linnaeus	IV(N)
Cassidae	
Cassis cornuta (Linnaeus)	SbVB
Muricidae	
Drupa grossularia Roding	IV, IL, SbVB
D. morum Roding	IV, SbVB
D. ricinus (Linnaeus)	IV, IL, SbVB
Morula granulata (Duclos)	IV
M. uva (Roding)	IV, IL, SbVB
Morula sp. 1	SbVB
Morula sp. 2	IL
Morula sp. 3	SbVB
Purpura persica (Linnaeus)	Sp
Thais armigera (Link)	IV
Buccinidae	
unident. sp.	IV
Fasciolariidae	
Latirus sp. 1	SbVB
Latirus sp. 2	SbVB
Peristernia nassatula (Lamarck)	IL, SbVB

Table 5. continued.

Olividae	
Oliva sp.	SbVB
Vasidae	
Vasum ceramicum (Linnaeus)	IV, SbVB
Mitridae	
Imbricaria punctata (Swainson)	SbVB
Mitra punctata (Swainson)	SbVB
M. coffea Schubert & Wagner	SbVB
Pusia tuberosa (Reeve)	SbVB
Vexillum sp. 3	SbVB
Vexillum sp. 4	SbVB
Conidae	
Conus episcopus Bruguiere	SbVB
C. miles Linnaeus	IL(N), SbVB
C. miliaris Bruguiere	SbVB
C. pulicarius Bruguiere	SbVB
C. rattus Hwass in Bruguiere	IV, IL
C. sponsalis Bruguiere	IL, SbVB
C. striatus Linnaeus	SbVB
C. tulipa Linnaeus	SbVB
Conus sp. 1	SbVB
Conus sp. 3	SbVB

Opisthobranchia (Identifications by P. J. Hoff and C. Carlson)*

Smaragdinella calyculata (Broderip & Sowerby)
Haminoea cymbalum (Quoy & Gaimard)
Haminoea sp. 1
Haminoea sp. 2
Atys? sp.
Acteonicina sp.
Gasteropteron flavum Tokioka & Baba
Chelidonura hirundinina (Quoy & Gaimard)
Ilbia sp.
Aplysia sp. (cf. *parvula*)
Dolabrifera dolabrifera (Rang)
Styocheilus longicauda (Quoy & Gaimard)
Cyerce sp.
Ercolania sp.
Hermaeina smaragdina (Baba)
Elysia bayeri Marcus
E. gracilis Risbec
E. halimedae Macnae
E. vatae Risbec
Gymnodoris sp.
Nembrotha luteolineata Baba
Okadaia elegans Baba

Table 5. continued.

Fryeria ruppellii Bergh
unident. eolid
*extracted from separate report, detailing characteristics of "sp." forms.

Pulmonata
Melampus flavus (Gmelin)

Bivalvia
Tridacna maxima (Roding)
T. squamosa Lamarck

Arthropoda
Crustacea
Anomura (Identifications by D. Wooster)
Diogenidae
Asiculus aniculus (Fabricius)
Calcinus elegans (H. Milne Edwards)
Calcinus sp. (aff. pulcher Forest
Dardanus guttatus (Olivier)
D. lapopodes (Forskal)

Coenobitidae
Birgus latro (Linnaeus)
Ccenobita brevimanus Dana
C. perlata H. Milne Edwards

Brachyura
Calappidae
Calappa hepatica (Linnaeus)

Grapsidae
Grapsus tenuicrustatus (Herbst)

Hapalocarcinidae
Hapalocarcinus marsupialis Stimpson

Echinodermata
Asteroidea
Acanthaster planci (Linnaeus)
Asterina burtoni Gray
Linckia multifora (Lamarck)

Crinoidea (Identifications by D. L. Meyer)
Comanthina schlegeli (Carpenter)
Comaster sp.

Echinoidea
Colobocentrotus mertensi Brandt

Table 5. continued.

Diadema savignyi Michelin
Echinometra mathaei (deBlainville)
Echinothrix sp.

Ophiuroidea (Identifications by F. W. E. Rowe)
Ophiolepis superba H. L. Clark
?Placophiothrix westwardi (Devaney)

Holothuroidea (Identifications by J. Doty)
Actinopyga mauritiana (Quoy & Gaimard)
Bohadschia argus Jaeger
B. marmorata Jaeger
Holothuria (Halodiema) atra Jaeger
H. (H.) edulis Lesson
H. (Platyperona) difficilis Semper
H. (Thymiosycia) hilla Lesson
Stichopus chloronotus Brandt
Thelenota ananas (Jaeger)
unident. synaptid

FISHES

Fishes have been identified from Maug on four previous trips. The first were those collected or observed by R. S. Jones and H. T. Kami aboard the "U.S.N. Grasp" in February 1971. In January 1975, M. Gawel collected and identified a number of fish at the west end of North Island during the "New World" expedition. The use of a poison station at that time yielded numerous small and cryptic species not previously recorded. The "Lindblad Explorer" (1976, 1977) reports to the Resident Commissioner listed 114 and 65 species, respectively. The latter expedition added 14 new species to the 1975 listing. A total of 110 species of fish in 35 families are reported from the fifth expedition aboard the "Eiriyo Maru No. 3". A comparison of the fish species collected or observed during the five expeditions is presented in Table 6.

During the fifth trip aboard the "Eiriyo Maru No. 3", the fish species were semi-quantified for the first time. Censuses of fish were accomplished by making repeated random swims through specific areas in the Maug lagoon and at one seaward site at West Island, and recording the names and relative abundance of each species encountered. To supplement these data, tows along side the boat were made near the shoreline of the three islands. The relative abundance of the fish species observed was determined as follows: abundance (A), clearly dominant (or co-dominant) throughout the study area, usually large schools of 100 or more fish; common (C), occurring regularly throughout the study area, 50 to 100 individuals of a particular species observed; occasional (O), observed infrequently throughout the study area or as a total of less than 50 individuals; and rare (R), observed five or fewer times in the course of the study.

The greatest number of individuals and diversity was recorded from the reef communities at the north end of East Island and central region of West Island. The boulder substrate along the lagoon side of North Island showed moderate diversity; however, no large schools were observed. The most abundant fishes in all habitats within the study were the herbivorous kyphosids and acanthurids. The dominant acanthurids were Acanthurus lineatus, A. leucopareius, Ctenochaetus striatus, and Naso lituratus. Of the two species of kyphosids, Kyphosus cinerascens was dominant. Stomach contents of both Acanthurus leucopareius and Kyphosus cinerascens were analyzed and the results are reported in the algal section. On the seaward side of West Island the number and diversity of pomacentrids increased. Two species, Chromis caerulea and Pomacentrus melanopterus, which did not appear in the lagoon were observed there.

An exploratory fishing survey in the offshore areas of Maug aboard the "Daikatsu-Maru" reported ten fish species (Table 7). A total of 4,400 pounds of fish were caught (Micronesian Coordnated Development Co., Ltd., 1976). Bottom fishing in the lagoon and trolling the offshore waters of Maug aboard the "Eiriyo Maru No. 3" yielded 12 species (Table 7).

Table 6. Checklist of fishes found at Maug. G = "U.S.N. Grasp" expedition, NW = "New World" expedition, L76 = "Lindblad Explorer" 1976 expedition, L77 = "Lindblad Explorer' 1977 expedition, and E = "Eiriyo Maru No. 3" expedition. Symbols indicating relative abundance of the species observed at each site: A=abundant, C=common, O=occasional, R=rare, - = not observed or collected. X=observed or collected.

FAMILY/SPECIES	G	NW	L76	L77	E
ACANTHURIDAE					
Acanthurus achilles Shaw	X	-	-	-	-
A. bleekeri Gunther	-	-	X	X	-
A. dussumieri Cuvier & Valenciennes	X	-	-	-	-
A. gahhm (Forsskal)	X	-	-	-	-
A. glaucopareius Cuvier	X	-	X	X	C
A. guttatus Bloch	X	-	-	-	C
A. leucopareius (Jenkins)	X	-	X	X	A
A. lineatus (Linnaeus)	X	-	X	X	A
A. nigrofuscus (Forsskal)	X	-	-	-	-
A. olivaceous Bloch & Schneider	X	-	X	X	O
A. pyroferus Kittliz	X	-	X	X	O
A. thompsoni (Fowler)	X	-	-	-	-
A. triostegus (Linnaeus)	X	-	X	-	O
A. xanthopterus (Cuvier & Valenciennes)	X	-	-	-	O
Acanthurus sp.	-	-	-	X	-
Ctenochaetus hawaiiensis Randall	X	-	-	-	-
C. striatus (Quoy & Gaimard)	X	-	X	X	A
Naso brevirostris Cuvier & Valenciennes	X	-	X	X	R
N. lituratus (Bloch & Schneider)	X	-	X	X	A
N. tuberosa (Lacepede)	X	-	-	-	R
N. unicornus (Forsskal)	-	-	-	-	R
Paracanthurus hepatus (Linnaeus)	-	-	X	X	-
Zebrasoma flavescens (Bennett)	X	-	X	X	O
APOGONIDAE					
Apogon angustatus (Smith & Radcliffe)	-	X	-	-	-
A. erythrinus Snyder	-	X	-	-	-
A. nigrofasciatus Lachner	X	-	-	-	-
A. snyderi Jordan & Evermann	-	X	-	-	-
Apogon sp. (cf. aureus)	-	X	-	-	-
Ostorhynchus endekataenia (Bleeker)	-	-	X	-	-
Paramia sp. (cf. quinquelineata)	-	-	X	-	-
AULOSTOMIDAE					
Aulostomus sp.	-	-	X	-	R

Table 6. continued.

FAMILY/SPECIES	G	NW	L76	L77	E
BALISTIDAE					
Balistapus undulatus (Mungo Park)	X	X	X	X	O
Melichthys niger (Bloch)	X	-	-	-	C
Melichthys vidua Solander	X	-	X	X	C
Odonus niger (Ruppell)	X	-	-	-	-
Rhinecanthus rectangulus (Bloch & Schneider)	-	-	X	-	-
Sufflamen bursa (Bloch & Schneider)	X	-	X	X	O
S. chrysoptera (Bloch & Schneider)	-	-	X	X	-
Xanthichthys ringens (Linnaeus)	-	-	X	X	-
BLENNIDAE					
Alticus saliens (Lacepede)	X	-	-	-	-
Aspidontus sp. (cf. tractus)	-	-	X	-	-
Diplomus sp.	-	-	X	X	-
Exallias sp.	-	-	X	X	-
Meiacanthus grammistes (Valenciennes)	-	-	X	X	-
Plagiotremus tapeinosoma (Bleeker)	X	-	X	-	-
Plagiotremus sp. (cf. rhinorhynchus)	-	-	X	-	-
BOTHIDAE					
Bothus sp. (cf. pantherinus)	-	-	X	-	-
BROTULIDAE					
Brotula multibarbata Temminck & Schlegel	X	X	-	-	-
Dinematichthys ilucocoeteoides (Bleeker)	-	X	-	-	-
CANTHIGASTERIDAE					
Canthigaster bennetti (Bleeker)	-	X	-	-	-
C. cinctus Solander	X	-	-	-	-
C. janthinopterus (Bleeker)	-	-	-	X	R
C. valentini (Bleeker)	-	-	-	-	R
CARACANTHIDAE					
Carachanthus maculatus (Gray)	-	X	-	-	-
C. unipinnus (Gray)	X	-	-	-	-
CARANGIDAE					
Caranx lugubris Poey	X	-	-	-	O
C. melampygus Cuvier	X	-	X	-	C

Table 6. continued.

FAMILY/SPECIES	G	NW	L76	L77	E
CARCHARHINIDAE					
Carcharhinus menisorah (Muller & Henle)	X	-	X	-	O
Triaenodon obesus (Ruppell)	-	-	-	-	R
CHAETODONTIDAE					
Chaetodon auriga Fosskal	X	-	X	-	O
C. citrinellus Cuvier	-	-	X	-	-
C. ephippium Cuvier	X	-	-	-	O
C. lunula (Lacepede)	X	-	-	-	O
C. mertensii Cuvier & Valenciennes	X	-	X	-	O
C. ornatissimus Cuvier & Valenciennes	X	-	X	-	O
C. punctatofasciatus Cuvier	X	-	X	-	R
C. quadrimaculatus Gray	X	-	X	-	O
C. reticulatus Cuvier	X	-	X	-	O
Forcipiger flavissimus Jordan & McGregor	X	-	X	-	O
F. longirostris (Broussonet)	X	-	-	-	R
Hemitaurichthys polylepis (Bleeker)	-	-	-	-	R
H. zoster (Bennett)	X	-	-	-	-
Heniochus permutatus Cuvier	X	-	X	X	-
CIRRHITIDAE					
Amblycirrhitus bimacula (Jenkins)	-	X	-	-	-
Cirrhitichthys falco Randall	-	-	X	X	O
C. serratus Randall	X	-	-	-	-
Cirrhitus sp.	-	-	X	X	-
Neocirrhites armatus Castelnau	X	X	-	-	O
Paracirrhites arcatus (Cuvier & Valenciennes)	-	-	X	X	R
P. forsteri (Bloch & Schnedier)	X	-	X	X	O
ECHELIDAE					
Kaupichthys sp.	-	X	-	-	-
ELEOTRIDAE					
Eleotroides strigatus (Broussonet)	X	X	-	X	O
Xenistmus sp.	-	X	-	-	-
"eleotrid" sp. 1	-	X	-	-	-
"eleotrid" sp. 2	-	X	-	-	-
"eleotrid" sp. 3	-	X	-	-	-
ENGRAULIDAE					
Thrissina sp.	-	-	X	-	C

Table 6. continued.

FAMILY/SPECIES	C	NW	L76	L77	E
EXOCOETIDAE					
Cypselurus artisignis Jenkins	-	-	X	-	-
C. poecilopterus (Valenciennes)	-	-	X	-	-
C. simus Cuvier & Valenciennes	-	-	X	-	-
Exocoetus volitans Linnaeus	-	-	X	-	-
FISTULARIIDAE					
Fistularia petimba Lacepede	-	-	X	-	-
GOBIIDAE					
Acentrogobius sp. (cf. puntang)	-	X	-	-	-
Cryptocentris sp.	X	-	-	-	-
Eviota sp. (cf. nebulosa)	X	X	-	-	-
Gobiodon sp.	X	-	-	-	-
"Goby" sp. (cf. subfamily Sicydiaphiinae)	-	X	-	-	-
"Goby" sp.	-	X	-	-	R
Lythrypnus sp.	X	X	-	-	-
Nemateleotris magnificus Fowler	X	-	X	X	O
Ptereleotris microlepis (Bleeker)	X	-	-	-	-
P. tricolor Smith	-	-	X	X	O
Quisquilius eugenius (Jordan & Evermann)	-	X	-	-	-
HEMIRHAMPHIDAE					
unidentified sp.	X	-	-	-	O
HOLOCENTRIDAE					
Adioryx caudimaculatus (Ruppell)	-	-	X	-	O
A. spinifer (Forsskal)	X	-	X	-	O
A. tiere (Cuvier & Valenciennes)	X	-	-	-	-
Adioryx sp.	-	X	-	-	O
Holotrachys lima (Valenciennes)	-	X	-	-	-
Myripristis berndti Jordan & Evermann	X	-	-	-	-
M. murdgan (Forsskal)	-	-	X	-	-
KUHLIIDAE					
Kuhlia taeniura (Cuvier & Valenciennes)	X	-	X	-	O
KYPHOSIDAE					
Kyphosus cinerascens (Forsskal)	X	-	-	-	A
K. lembus (Cuvier)	-	-	X	-	C

Table 6. continued.

FAMILY/SPECIES	G	NW	L76	L77	E
LABRIDAE					
Anampses caeruleopunctatus Ruppell	X	-	-	X	O
Bodianus axillaris (Bennett)	X	-	X	X	O
Bodianus sp.	-	-	X	-	-
Cheilinus rhodochrous Gunther	X	-	-	-	-
Choerodon azurio (Jordan & Snyder)	-	-	-	X	-
Coris aygula Lacepede	-	-	X	X	R
C. gainardi (Quoy & Gaimard)	X	-	X	X	-
Gomphosus varius Lacepede	X	-	X	-	O
Halichoeres centriquadrus (Lacepede)	X	-	X	X	O
H. hoeveni (Bleeker)	-	-	X	X	-
H. notopsis (Valenciennes)	-	-	X	X	-
H. trimaculatus (Quoy & Gaimard)	-	-	-	-	O
Halichoeres sp.	X	-	-	-	-
Hemigymnus fasciatus (Bloch)	X	-	X	X	O
H. melapterus (Bloch)	-	-	-	-	O
Labroides bicolor Fowler & Bean	X	-	-	X	O
L. dimidiatus (Cuvier & Valenciennes)	X	-	X	X	O
Macropharyngodon meleagris (Cuvier & Valenciennes)	X	-	-	X	O
Pseudocheilinus hexataenia (Bleeker)	-	-	X	X	-
Stethojulis albovittata (Bonnaterre)	-	-	X	X	O
S. axillaris (Quoy & Gaimard)	X	-	-	X	O
S. strigiventer (Bennett)	-	X	-	-	-
Thalassoma amblycephala (Bleeker)	-	-	X	-	O
T. lutescens (Lay & Bennett)	X	-	X	X	C
T. purpureum (Forsskal)	X	-	-	-	-
T. quinquevittata (Lay & Bennett)	-	X	X	X	C
Thalassoma sp.	-	-	X	X	-
Xyrichthys taeniourous (Lacepede)	X	-	X	-	-
LUTJANIDAE					
Aphareus furcatus (Lacepede)	X	-	-	-	-
Aprion virescens (Cuvier & Valenciennes)	X	-	-	-	-
Caesio sp.	X	-	X	-	O
Lutjanus bohar (Forsskal)	X	-	-	-	C
L. gibbus (Forsskal)	X	-	-	-	-
L. kasmira (Forsskal)	X	-	X	-	O
Lutjanus sp.	-	-	X	-	-
Macolor niger (Forsskal)	X	-	-	-	R
Monotaxis grandoculis (Forsskal)	X	-	X	-	-
Paracaesio xanthurus (Bleeker)	-	-	X	-	O
Plectorhynchus shotaf	-	-	X	-	-

Table 6. continued.

FAMILY/SPECIES	G	NE	L76	L77	E
MALACANTHIDAE					
Malacanthus latovittatus (Lacepede)	X	-	-	-	-
MONOCANTHIDAE					
Oxymonocanthus longirostris (Bloch & Schneider)	X	-	-	-	-
MUGILIDAE					
Crenimugil crenilabis (Forsskal)	-	-	X	-	O
MUGILOIDIDAE					
Parapercis cephalopunctata (Seale)	X	-	-	-	O
MULLIDAE					
Mulloidichthys auriflamma (Forsskal)	X	-	-	-	-
M. samoensis Gunther	-	-	X	-	O
Parupeneus barberinus (Lacepede)	-	-	-	-	O
P. bifasciatus (Lacepede)	X	-	-	-	C
P. cyclostomes (Lacepede)	-	-	X	-	-
P. luteus (Cuiver & Valenciennes)	X	-	-	-	-
P. moluccensis (Bleeker	-	-	-	-	O
P. multifasciatus (Quoy & Gaimard)	X	-	-	-	-
P. trifasciatus (Lacepede)	-	-	X	-	-
Parupeneus sp.	-	-	X	-	-
MURAENIDAE					
Gymnothorax buroensis (Bleeker)	-	X	-	-	-
G. flavimarginatus (Ruppell)	-	X	-	-	-
G. margitophorus (Bleeker)	-	X	-	-	-
NEMIPTERIDAE					
Gnathodentex aurolineatus (Lacepede)	-	-	X	-	O
OPHICHTHIIDAE					
Myrichthys sp.	-	X	-	-	-
OSTRACIONTIDAE					
Ostracon meleagris Shaw	-	-	X	X	R

Table 6. continued.

FAMILY/SPECIES	G	NW	L76	L77	E
PEMPHERIDAE					
Pemphis cualensis Cuvier	X	-	-	-	-
P. japonica Doderlein	-	-	X	-	O
PLATYCEPHALIDAE					
Thysanophrys crocodilus (Tilesrus)	-	-	X	-	-
POMACANTHIDAE					
Centropyge bispinosus (Gunther)	X	-	X	X	-
C. flavissimus (Cuvier)	X	X	X	X	C
Pomacanthus imperator (Bloch)	X	-	X	X	R
Pygoplites diacanthus (Boddaert)	-	-	X	X	R
POMACENTRIDAE					
Abudefduf coelestinus (Lacepede)	X	-	-	-	-
A. imparipennis (Vaillant & Sauvage)	-	-	X	-	-
A. saxatilis (Linnaeus)	-	-	X	X	C
A. septemfasciatus (Cuvier & Valenciennes)	X	-	-	-	-
A. sordidus (Forsskal)	-	-	X	-	C
Amphiprion akindynos Allen	-	-	X	-	-
A. clarkii (Bennett)	-	-	-	X	R
A. periderion (Bleeker)	-	-	-	X	-
Chromis caerulea (Cuvier)	-	-	-	X	O
C. leucurus Gilbert	X	-	-	-	-
C. margaritifer Fowler	-	-	X	X	O
C. xanthochir (Bleeker)	X	-	-	-	-
Chromis sp. (cf. *xanthochir*)	-	X	-	-	-
Chromis sp.	-	-	X	X	O
Dascyllus aruanus (Linnaeus)	-	-	X	-	-
D. reticulatus (Richardson)	-	-	X	X	R
D. trimaculatus (Ruppell)	X	-	X	X	-
Eupomacentrus fasciolatus (Ogilby)	X	X	-	-	-
E. nigricans (Lacepede)	X	-	-	X	-
Plectoglyphidion dickii (Lienard)	X	-	-	X	C
Pomacentrus johnstonianus (Fowler & Ball)	X	-	-	-	C
P. lacrymatus (Quoy & Gaimard)	X	-	-	-	-
P. melanopterus Bleeker	-	-	-	-	O
P. vaiuli (Jordan & Seale)	X	-	-	-	-
Pomacentrus sp.	-	-	X	X	-
PSEUDOCHROMIDAE					
Pseudogramma polyacantha (Bleeker)	X	X	-	-	-

Table 6. continued.

FAMILY/SPECIES	G	NW	L76	L77	E
SCARIDAE					
Calotomus spinidens (Quoy & Gaimard)	X	-	-	-	O
Scarops rubriviolaceous Bleeker	X	X	X	-	C
Scarus capistratoides Bleeker	-	-	X	-	C
S. lepidus Jenyns	X	X	-	-	C
Scarus sp. 1	X	X	X	-	-
Scarus sp. 2	-	-	-	-	C
Scarus sp. 3	-	-	-	-	O
SCOMBRIDAE					
Euthynnus affinis (Cantor)	-	-	X	-	-
SCORPAENIDAE					
Pterois antennata (Bloch)	-	X	-	-	-
P. volitans (Linnaeus)	X	-	-	X	-
SERRANIDAE					
Cephalopholis argus (Bloch & Schneider)	-	-	X	-	O
C. miniatus (Forsskal)	X	-	-	-	-
C. rogaa (Forsskal)	-	-	X	-	-
C. urodelus (Bloch & Schneider)	X	-	X	-	O
Epinephelus emoryi Schultz	X	-	-	-	-
E. maculatus (Bloch)	-	-	X	-	O
Plectropoma melanoleucus (Lacepede)	-	-	-	-	R
Variola louti (Forsskal)	X	-	X	-	O
SPHYRAENIDAE					
Spyraena barracuda (Walbaum)	X	-	-	-	R
SYNODONTIDAE					
Synodus variegatus (Lacepede)	-	X	-	-	-
Synodus sp. (cf. *binotatus*)	-	X	-	-	-
Synodus sp.	-	X	-	-	R
unidentified sp.	X	-	-	-	-
TETRADONTIDAE					
Arothron nigropunctatus (Bloch & Schneider)	X	-	-	-	R

Table 6. continued.

FAMILY/SPECIES	G	NW	L76	L77	E
TRIPTERYGIIDAE					
Helicgramma sp.	-	X	-	-	-
ZANCLIDAE					
Zanclus cornutus (Linnaeus)	X	X	X	X	O
Total Species	120	44	112	65	110

Total Number of Species in Five Expeditions: 232

Table 7. Results of an exploratory fishing survey of the "Daikatsu-Maru" (DM) and bottom fishing and trolling of the "Eiriyo Maru No. 3" (EM).

SPECIES	DM	EM
Etelis sp.	113	
Pristipomoides sieboldi	40	
Tropidnius sp.	39	
Aprion virescens	3	
Seriola sp.	7	
Gymnosarda sp.	8	
Caranx sp.	12	
Epinephelus sp.	8	1
Tuna	30	
Acanthocybium solandri		2
Elagatus bipinnulatus		2
Lutjanus kasmira		2
Caranx lugubris		17
Lutjanus bohar		23
Caesio sp.		1
Variola louti		1
Cephalopholis argus		2
Nemipterus marginatus		2
Carcharinus menissorah		47
Other species	26	2
Total No. of Individuals	286	102

TERRESTRIAL ENVIRONMENT

TERRESTRIAL PLANTS AND VEGETATION PATTERNS

The earliest record of terrestrial vascular plants from the island of Maug dates back to Fritz (1902) who mentions three species -Miscanthus floridulus, Cocos nucifera, and Hernandis sonora. In a booklet by Lehre and Gabler (1972), "Bluhende Baumwolle" (Gossypium hirsutum) is mentioned as being present on Maug. The most thorough floristic study on the vascular plants of the northern Mariana Islands is that of Fosberg et al. (1975). The species reported in this paper were collected from Maug by M. V. C. Falanruw in 1972 aboard the motor sailing ship "Wanderer." An additional listing of plants from Maug was published by Fosberg et al. (1977) based on collections made by various individuals in July 1975 aboard the motor sailing ship "New World". A report to the Resident Commissioner in Saipan by Sir Peter Scott includes four additional species from Maug (Lindblad Explorer, 1976).

Vegetation Patterns

Approaching the islands of Maug from any direction, the steep slopes appear to be covered with a lush low growing vegetation. Scattered here and there can be seen dark and light green patches which appear to be pure stands of species which are unrecognizable at a distance. Also noticeable are fingerlike stands of single species, some obviously low growing and others taller. At the summit of each island a few tall trees can be seen against the skyline.

Only two species can be easily recognized, Cocos nucifera, introduced by the Japanese or perhaps by members of an earlier settlement mentioned elsewhere in the report, and Casuarina equisetifolia. The latter species is quite obvious on the highest point of East Island and was probably planted there by the Japanese to provide some shelter for their weather station. A closer look at the accessible slopes on the lagoon sides, however, reveal individual species which can be recognized with binoculars. One large stand and several smaller stands of Cocos nucifera are obvious from the sea on East Island.

East Island

The valleys on the lagoon side slope at angles varying from about 45 to 60 degrees and are matted by a variety of low growing grasses, sedges, herbs and vines. These are separated by rocky ridges which vary in height and width. Here, three species of ferns (Asplenium nidus, Polypodium scolopendria and Pteris quadriaurita) can be found growing along the base or in rocky crevises.

Four grasses are known from Maug-Digitaria mariannensis, Miscanthus floridulus (sword grass), Stenotaphrum micranthum and Zoysia matrella (temple grass). These grasses vary in density and any one of these grasses may occur as the predominant plant in a given area. Generally, the sword grass inhabits the higher elevations. The Japanese temple grass grows best on the lower slopes, although it was collected at the summit of East Island. Growing among the grasses can be found the large sedge Cyperus javanica; four vines which include Wedelia biflora, Operculina ventricosa (wood rose), Colubrina asiatica and Ipomoea pes-caprae; the shrub Capparis cordifolia common on all three islands and considered endangered in the southern Marianas; several herbs including Vernonia cinerea, Phyllanthus marianus, P. amarus, Hyptis pectinata; and three species of Portulaca.

Terminalia catappa can be seen as round dark green patches scattered over the entire inner slope of East Island. These stands are easily recognizable because they serve as a preferred resting and nesting site for sea birds which appear as white dots from a distance. Morinda citrifolia appears as smaller dark green patches and Pipturus argenteus as somewhat lighter areas. Several finger-like patches of Hibiscus tiliaceus which appear rather straggly with few leaves and numerous dead stems occur particularly on the lower slopes. At least two substantial stands of Piscnia grandis and at least one stand of Vitex negundo appear on the inner slope. At lower elevations, large stands of Crinum asiaticum can be easily recognized.

On the seaward side of East Island, various patches of vegetation can be recognized from a distance once the general shape and color are known. These stand out against the general background of low growing grasses, vines and herbs. Starting from the south end, Terminalia, Hibiscus and Pisonia can be seen as well as small groves of Cocos. In the mid-portion of the island where it is widest and evenly terraced is a large plantation of Cocos nucifera interspersed with a variety of other vegetation which could not be identified from a distance. Below the Cocos groves, thick stands of Pandanus tectorius and Crinum asiatica occur. One other small stand of Cocos is present north of the main plantation.

Two possible additions to the list of vascular plants are Ficus sp., collected at the summit of East Island and also tentatively identified at the top of North Island (seen with binoculars), and Physalis angulata, found at an elevation of ca. 30 meters near the north end of the island.

West Island

The general vegetation pattern on West Island is similar to that already described for East Island. The slopes are dominated

by Ipomoea pes-caprae, Wedelia biflora and Operculina ventricosa. Grasses and sedges are reduced in numbers; Capparis cordifolia is common and Terminalia catappa is conspicuous on all slopes.

Several species are found that are not seen on East Island. Pending positive identification, the plants are tentatively identified as Canavalia sp., Hedyotis sp., Capsicum sp., one composite, and one other member of the Nightshade family. Scaevola taccada is present at the summit of West Island but it was beyond reach. Thus, no collections could be made. This species was "sighted" by an earlier investigator (Lindblad Expedition, 1976). Gossypium hirsutum and Achyrantes canescers are also found here. Stands of Pipturus, Miscanthus, Pandanus and small stands of Capparis and Morinda are seen on the lagoon slopes.

On the outside, the grassy slopes are covered by what appears to be the same mixture of low growing plants, i.e., Wedelia, Ipomoea, Cyperus, Capparis and various grasses. Several large trees which appear to be Pandanus tectorius are present on the summit near the middle of the island. Toward the south end, large patches of Terminalia and Pisonia are present.

North Island

The summit of North Island is accessible only near the west end. Here the dominant species are Ipomoea, Cyperus javanica, Fimbristylis cymosa (which was not seen on the other two islands), and Capparis. On the west face of the island, large stands of Crinum appear on the lower slopes; Terminalia and Pisonia occur at higher elevations. On the seaward side of the island, the slopes are covered with similar low growing plants. Large patches of Miscanthus occur at the summit; Terminalia and Hibiscus occur below.

Several species noted earlier were not found during this recent trip. Notable among themare Hernandia sonora, Melochia compacta, Neiosperma oppositifolia, Trema orientalis and Cordia subcordata. These can very likely be found on the eastern slope of East Island and were probably planted there by the Japanese.

Phytogeographic Affinities

To date, 59 species of terrestrial vascular plants (3 ferns, 11 monocots, and 46 dicots) are known from Maug. See Table 8. None of the species listed are endemic only to the island of Maug; however, two species (Digitaria mariannensis and Phyllanthus marianus) are endemic to the Mariana Islands. One other species, Fimbristylis boninensis, is endemic to the Bonin Islands and the northern Mariana Islands. About 20 species can be considered to be pantropical with the remaining plants either of Pacific or Indo-Pacific distribution. The lily Crinum asiatica is the only plant which can be considered as an ornamental.

Table 8. Checklist and dominance of terrestrial vascular plants known from Maug. Checklist is based on compilation of species reported by Fosberg et al. (1975, 1977), Lindblad Expedition (1976), and this trip aboard the "Eiriyo Maru No. 3". Sight records by the Lindblad Expedition (1976) are preceded by a single asterisk; new records made on this trip are preceded by double asterisks. Abundant (A) = dominant plant over the entire area; Common (C) = may occur in pure stands or in clumps locally, but not generally present over entire area; Rare (R) = seldom seen.

Species	Dominance	Islands		
		East	West	North
Family Polypodiaceae				
Asplenium nidus L.	C	X	X	
Polypodium scolopendria Burm. f.	R	X	X	
Pteris quadriaurita Retzius	C	X	X	
Family Pandanaceae				
Pandanus tectorius Parkinson	C	X	X	X
Family Gramineae				
Digitaria mariannensis Merrill	A	X	X	X
Miscanthus floridulus (Labillardiere) Warb.	A	X	X	X
Stenotaphrum micranthum (Desvaux) Hubbard	C	X	X	X
Zoysia matrella var. *matrella* (L.) Merrill	A	X	X	X
Family Cyperaceae				
Cyperus cyperinus (Retz.) Sur.		(not seen)		
Cyperus javanicus Houttuyn	A	X	X	X
Fimbristylis boninensis Hayata		(not seen)		
Fimbristylis cymosa R. Brown	C			X
Family Palmae				
Cocos nucifera L.	A	X		
Family Liliaceae				
Crinum asiaticum L.	A	X	X	X
Family Casuarinaceae				
Casuarina equisetifolia L.	C	X		
Family Ulmaceae				
Trema orientalis var. *argentea* (Planchon) Lauterbach		(not seen)		

Table 8. continued.

Species	Dominance	Islands		
		East	West	North
Family Moraceae				
Ficus tinctoria var. *neo-ebudarum* (Summ.) Fosberg	C	X	X	X
**Ficus* sp.	R	X		X
Family Urticaceae				
Pipturus argenteus (Forster f.) Weddell	C	X	X	X
Family Amaranthaceae				
Achyranthes canescens R. Brown	R		X	
Family Nyctaginaceae				
Boerhavia repens L.		(not seen)		
Boerhavia sp.		(not seen)		
Pisonia grandis R. Brown	C	X	X	X
Family Aizoaceae				
Sesuvium portulacastrum L.		(not seen)		
Family Portulacaceae				
Portulaca australis Endlicher	C	X	X	X
Portulaca lutea Solander	C	X	X	X
Portulaca oleracea L.	C	X	X	X
Family Hernandiaceae				
Hernandia sonora L.		(not seen)		
Family Capparidaceae				
Capparis cordifolia Lamarck	C	X	X	X
Family Leguminosae				
**Canavalia sericea*		(not seen)		
***Canavalia* sp.	R		X	
**Derris elliptica* (Roxb.) Bentham		(not seen)		
Family Oxalidaceae				
Oxalis corniculata L.	R		X	
Family Euphorbiaceae				
Phyllanthus amarus Schumacher & Thonning	R	X		
Phyllanthus marianus Mueller-Argoviensis	R	X	X	
Family Rhamnaceae				
Colubrina asiatica (L.) Brongniart	R	X	X	

Table 8. continued.

Species	Dominance	Islands		
		East	West	North
Family Rubiaceae				
**Hedyotis foetida (Forster) J. E. Smith	R		X	
Morinda citrifolia L.	R	X	X	
Family Goodeniaceae				
*Scaevola taccada (Gaertner) Roxburgh = S. seriacea Vahl	R		X	
Family Compositae				
Vernonia cinerea (L.) Lessing	R	X	X	X
Wedelia biflora var. canescens (Gaudichaud) Fosberg	C	X	X	
**Compositae sp.	R		X	

TERRESTRIAL ANIMALS

Although the Lindblad Explorer (1976) reported no rats, individual Polynesian or roof rats were observed during July 1975, when one was seen in the cistern at the north end of East Island, and several were reported around the ruins of the Japanese weather station at the summit of East Island. During November 1977, one was seen at the north end of East Island where recent rat activity was evident at the base of Terminalia trees.

Fruits bats were observed during November 1977. These bats, Pteropus mariannus, are endemic to the Mariana Islands and are found throughout the chain. Individuals are becoming rare on Guam (and the other southern Marianas) and may be considered an "endangered species." The Northern Marianas Legislature has passed a moratorium on capturing and taking of fruit bats (and coconut crabs) in the northern islands (Public Law 5-21, September 9, 1977). This law prohibits the collection of either species for a period of one year following the date of signing. A subspecies P. m. paganesis, has been described from nearby Pagan (Yamashina, 1932).

Blue-tailed skinks and "golden skinks" were observed during January and July 1975, and during November 1977. No specimens were collected, however.

Several juvenile specimens of a terrestrial gastropod, Succinea sp. [Succineidae] were collected at an elevation of about 60 meters on East Island. These snails were crawling on the exposed surface of a basaltic boulder. Members of this family are widespread on Pacific islands and are found under a wide range of conditions (Solem, pers. comm.).

In the litter under heavy vegetation a number of micro-arthropods were observed. These include isopods, ground spiders, and several species of ants, and cockroaches. Two juvenile earthworm specimens were collected which are probably members of the African genus Dichogaster. These forms have been taken to many Pacific islands by Europeans over the past four hundred years (Gates, pers. comm.).

BIRDS

Sixteen species of birds are reported from Maug. Yamashina (1940) made the first records which included the red-tailed tropic bird, red-footed booby, and Pacific man-o-war. Falanruw (1975) reported the Micronesian megapode from Maug. All sixteen species were noted in a report to the Resident Commissioner of the Northern Marianas by Sir Peter Scott (Lindblad Explorer 1976). A second Lindblad Explorer (1977) report outlined most of the same species. Additional observations are reported here from trips aboard the "New World" in January 1975 by L. G. Eldredge and in July by C. Lamoureux and L. G. Eldredge, as well as one aboard the "Eiriyo Maru No. 3" in November 1977.

Of the sixteen species eleven are sea birds; two, shore birds; and three, land birds. Two land bird subspecies--Halcyon chloris owstoni and Aplonis opacus aeneus--are endemic to the northern islands of the Northern Marianas. The third endemic species--Megapodius laperouse laperouse--was established as an endangered species over its entire range and published in the Federal Register, September 26, 1975 (Vol. 40, No. 188, p. 44420) under the jurisdiction of the Endangered Species Act of 1973. It is also listed in the IUCN Red Data Book.

The red-footed booby was the most common sea bird observed during November 1977. During the day forty-one roosting individuals at the north end of East Island were counted during a two-minute period. In a valley on the west side of East Island, sixty red-footed boobies were counted in a stand of Pisonia trees. The Pacific man-o-war was also common. Individual Micronesian starlings and kingfishers were observed at all the islands.

The terminology, systematic arrangement, and subspecific determinations followed are those of Baker (1951) and as modified by Owen (1977). Table 9 is checklist of species known to occur at Maug.

Table 9. continued

	NW1	NW2	L76	L77	EM
*Anous minutus Boie [A. tenuirostris] (black or white-capped noddy)	-	-	X	X	-
*Gygis alba candida (Gmelin) (white tern)	X	X	X	X	X
Alcedinidae					
Halcyon chloris owstoni Rothchild (white-collared kingfisher)	X	X	X	X	X
Sturnidae					
Aplonis opacus aeneus (Takatsukasa & Yamashina) (Micronesian starling)	X	X	X	X	X

*Species listed in the "Convention between the Government of the United States of America and the Government of Japan for the protection of migratory birds and birds in danger of extinction, and their environment" signed at Tokyo March 4, 1972 and as amended and signed at Washington September 19, 1974.

UNUSUAL, RARE AND ENDANGERED SPECIES

Several different plant and animal species can be considered unusual, rare, or endangered. The presence of three species of marine algae found on Maug can be considered unusual or rare. Homoeostrichus flabellatus, a brown alga, is known from Micronesia only from specimens dredged to depths of 70-90 m at Guam. It was found at Maug only at the lagoon shore of East Island. Another brown alga, Stypopodium hawaiiensis, found at East and North Islands, has been previously reported from Truk and Hawaii. The red alga Laurencia succisa, rare at Maug, is the only Micronesian record for the species.

Two sea turtles were observed in November 1977. One of them was positively identified as a hawksbill turtle (Eretmochelys imbricata). This species has been placed on the official U. S. list of endangered species.

Porpoises were observed off the east coast of East Island during each of the two trips around Maug.

The fruit bat (or flying fox) Pteropus mariannus is present at Maug as it is on most of the other Mariana Islands. Since only one bat was actually seen at a time, it might be presumed that the total bat population is small. At other islands, numerous bats can be seen at one time. During preliminary considerations for an endangered species list for the Mariana Islands, the fruit bat has been suggested. Bats are presently under protection by the Northern Marianas Legislature's Public Law 5-21 which imposes a year-long moratorium on the capture of fruit bats. The species is listed in the IUCN Red Data Book.

Two Marianas endemic plant species, Phyllanthus marianus and Digitaria mariannensis, were abundant on all three islands.

Three endemic land birds--Halcyon chloris owstoni, Aplonis opacus aeneus, and Megapodius laperouse laperouse--occur at Maug. The first two species are seen commonly at all three islands. The Micronesian megapode has been reported from all three islands. It is a solitary-living ground bird and is not readily seen. In addition to Falanruw's (1975) record of the species, it has been observed during both of the "New World" and "Lindblad Explorer" visits to Maug. The Micronesian megapode has been established as an endangered species over its entire range under the jurisdiction of the Endangered Species Act of 1973. It is also listed in the IUCN Red Data Book.

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PLATES

PLATE I

Aerial photograph of Maug; East Island is in the foreground, and the deep entrance at the South to the left.

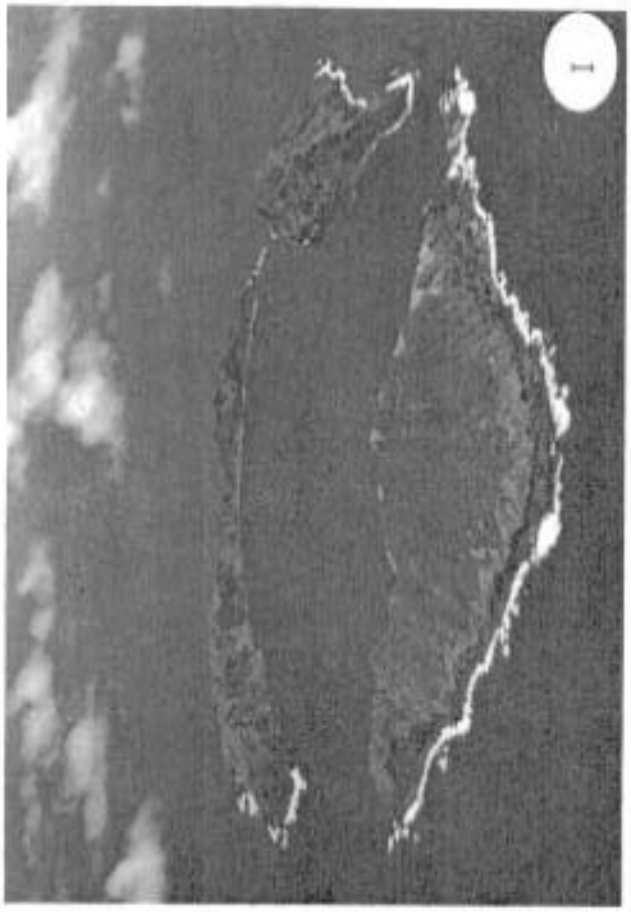


PLATE II

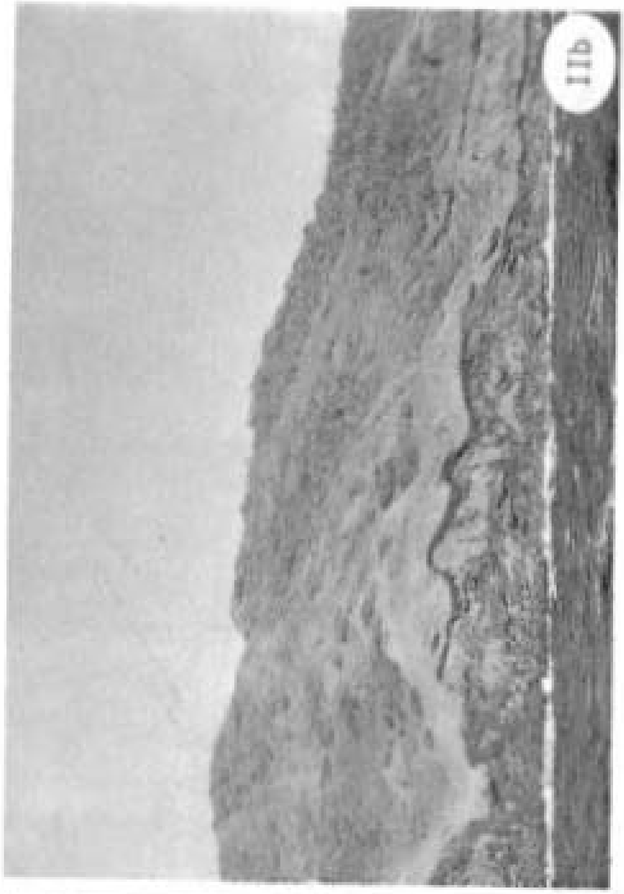
a. South end of East Island from the outside; the dominant vegetation patches are stands of *Terminalia*.

b. East Island from the outside; groves of coconut trees are found in the narrow valleys and increase in dominance toward the north (to the right).

c. East Island shore at widest (easternmost) point; coconuts are the dominant vegetation type.

d. Shoreline at easternmost point of East Island.

IIa



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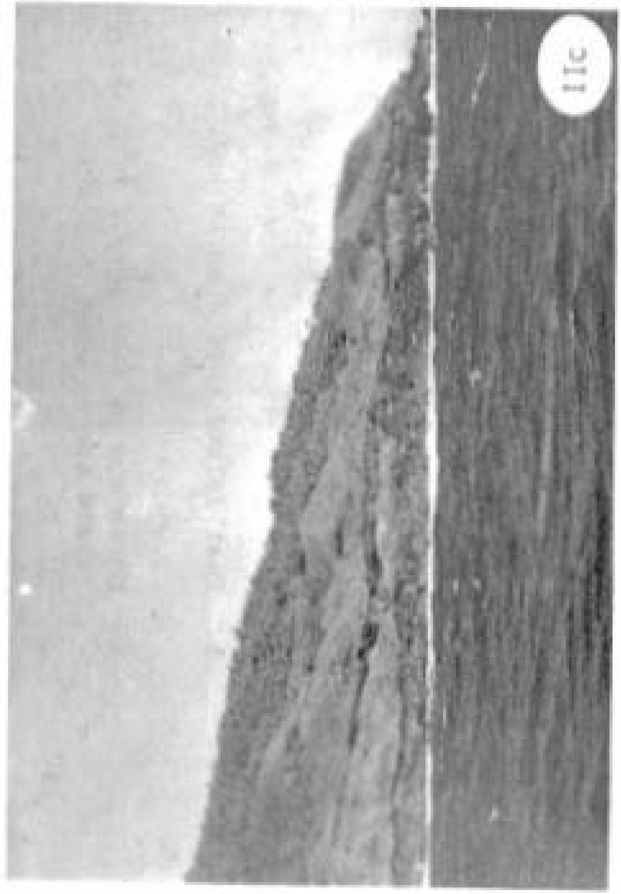

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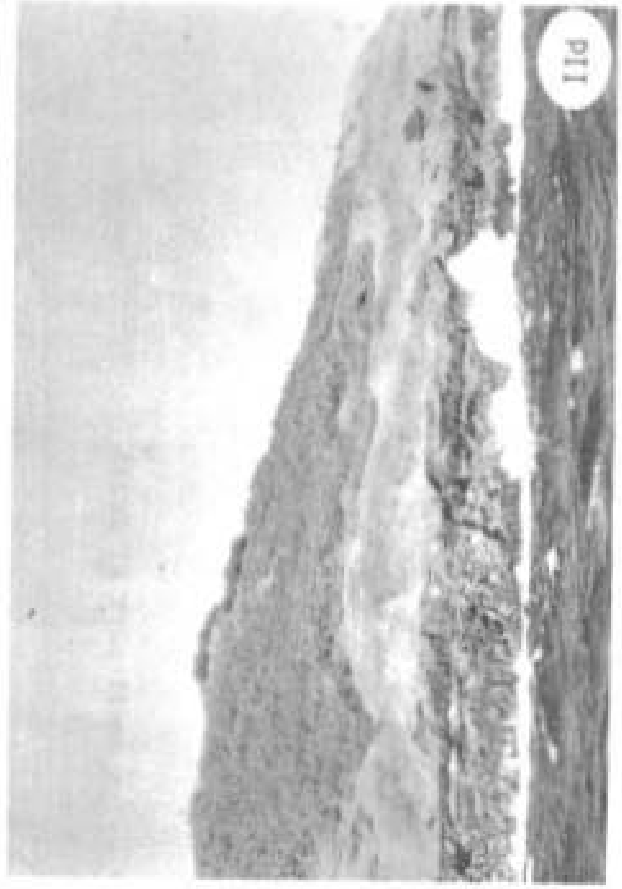


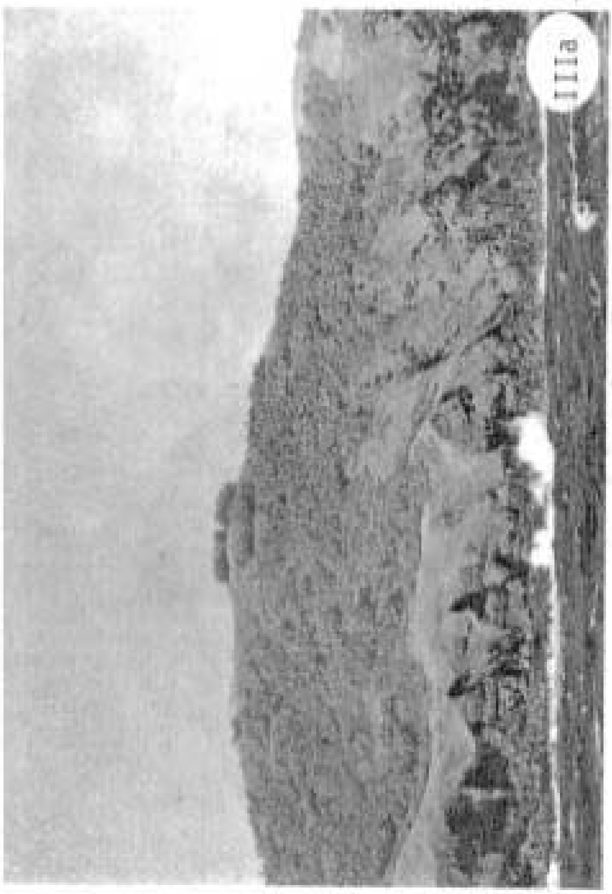
IId

PLATE III

a. East Island; Casuarina and coconut groves toward east.

b. East Island toward north end.

c. North end of East Island from the outside; a small part of North Island can be seen at right.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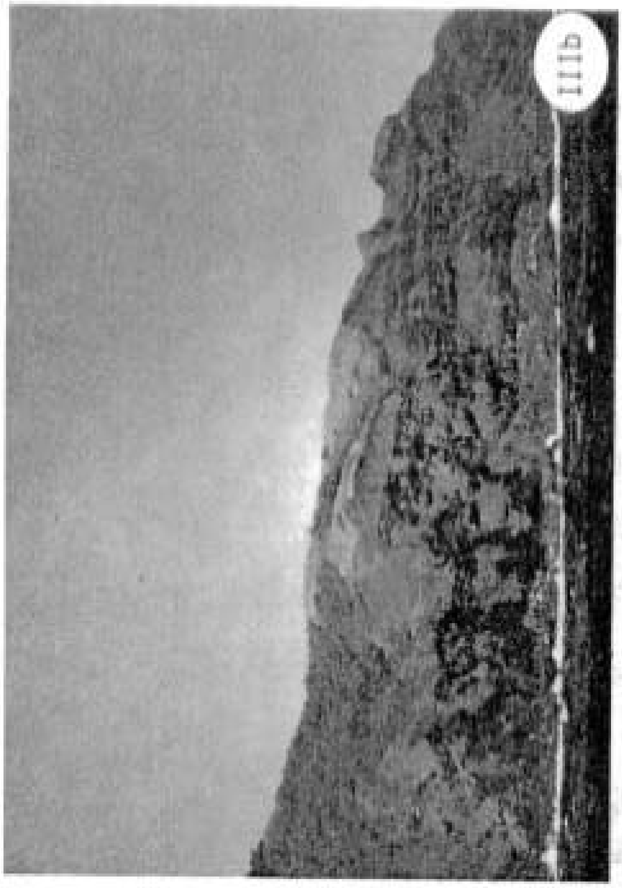

IIIb


IIIc

PLATE IV

a. Peak at East Island from inside; Casuarina grove surrounds weather station.

b. Northern elevation of East Island; vegetation covering is mixture of grasses and sedges.

c. Lower slopes of the inside of East Island; finger-like vegetational growth is Crinum, the taller plants are Hibiscus.

d. Lower slopes of inside of southern end of East Island; the taller plants to the right are Pisonia trees.


IVa


IVb

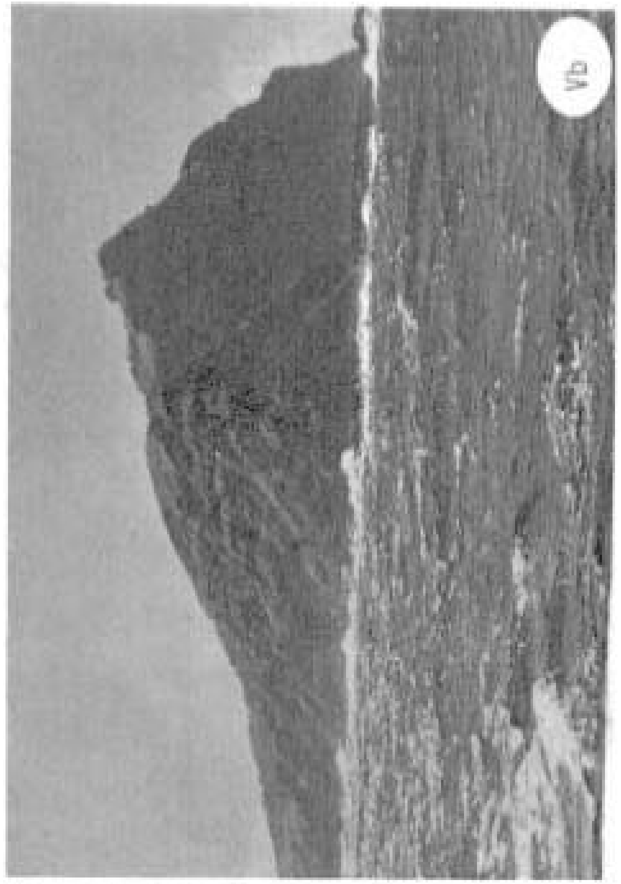

IVc


IVd

PLATE V

a. Truncated basaltic islet at north end of East Island.

b. Profile of East Island from the north.


Vb

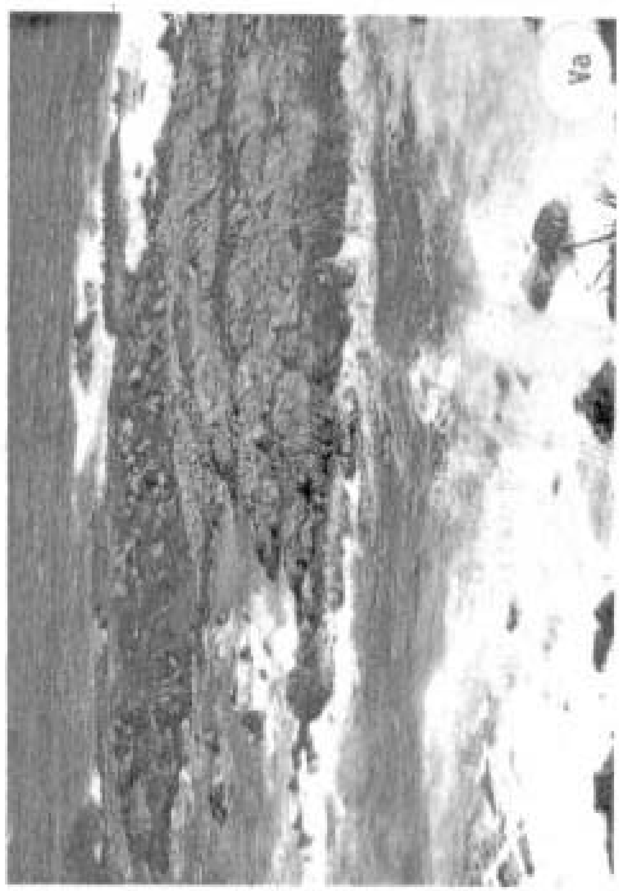

Va

PLATE VI

a. North Island from the outside; dominant vegetation is a low cover of grasses and sedges.

b. Valley at west of North Island; taller vegetation is a mixture of Hibiscus and Pandanus. Crinum is found in the lower valleys.

c. West end of North Island; the same Crinum as in VIb is at left.


VIa


VIb


VIc

PLATE VII

Plates VIIa, VIIb, and VIIc are a continuous sequence of the lagoon side of North Island.

a. West end of North Island.

b. Middle of North Island.

c. East end of North Island

d. Detail of inside of North Island; shoreline mainly blocks and boulders with small sand area, vegetation is low cover of grasses and sedges.


VIIa


VIIb


VIIc


VIId

PLATE VIII

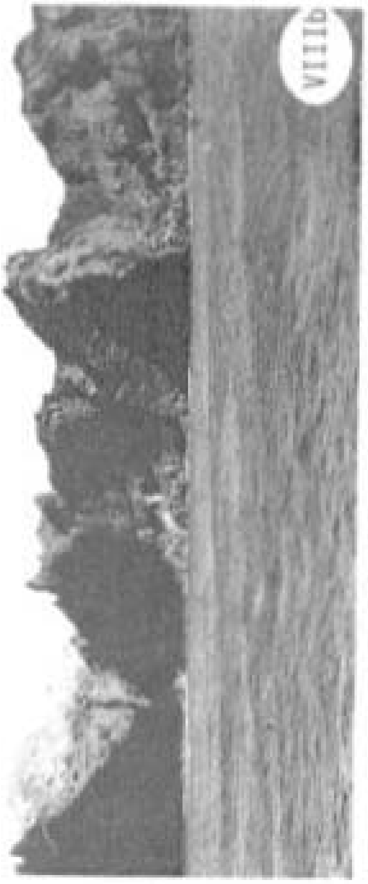
a. South end of West Island; mixed vegetation in uplands with scattered groves of Terminalia.

b. Profile of lowest parts of West Island, VIIId taken from lowest area to the right.

c. Middle of West Island from outside.

d. Outside slope of West Island taken from ridge; a fairly well developed fringing reef can be seen through the water.


VIIIa

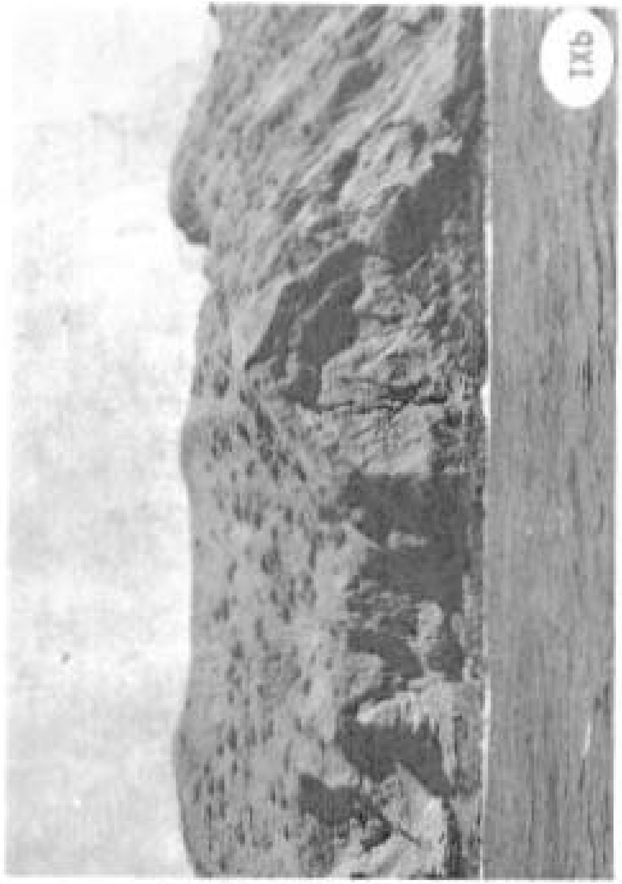

VIIIb


VIIIc


VIIId

PLATE IX

a-b. Outside of south end of West Island; vegetation low cover of mixed grasses and sedges, with scattered groves of Terminalia.


IXb

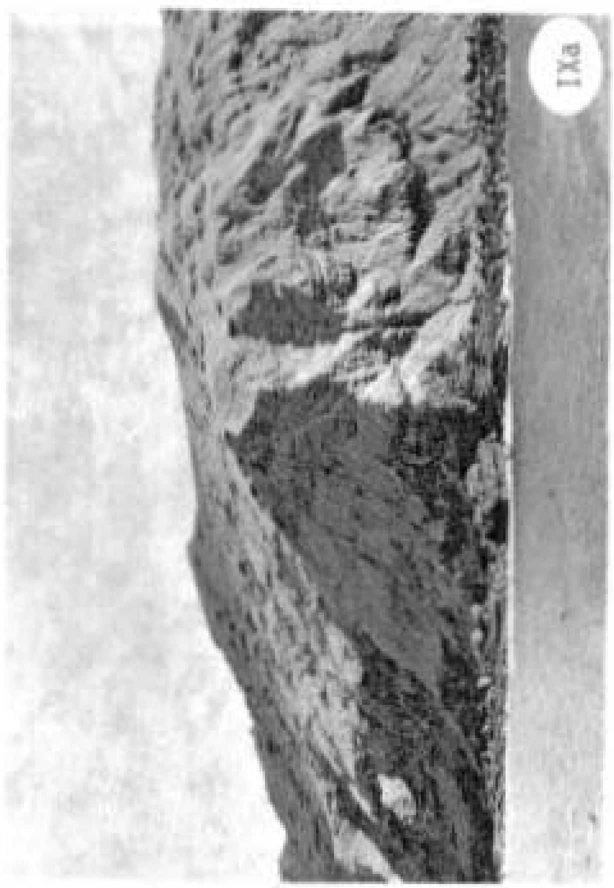

IXa

PLATE X

a. Valley on lagoon side of West Island; plants are scattered among boulders.

b. Bare cliffs at approximate middle of West Island.

c. Lagoon shore from ridge of West Island.

d. General view of inside of West Island taken from low ridge.

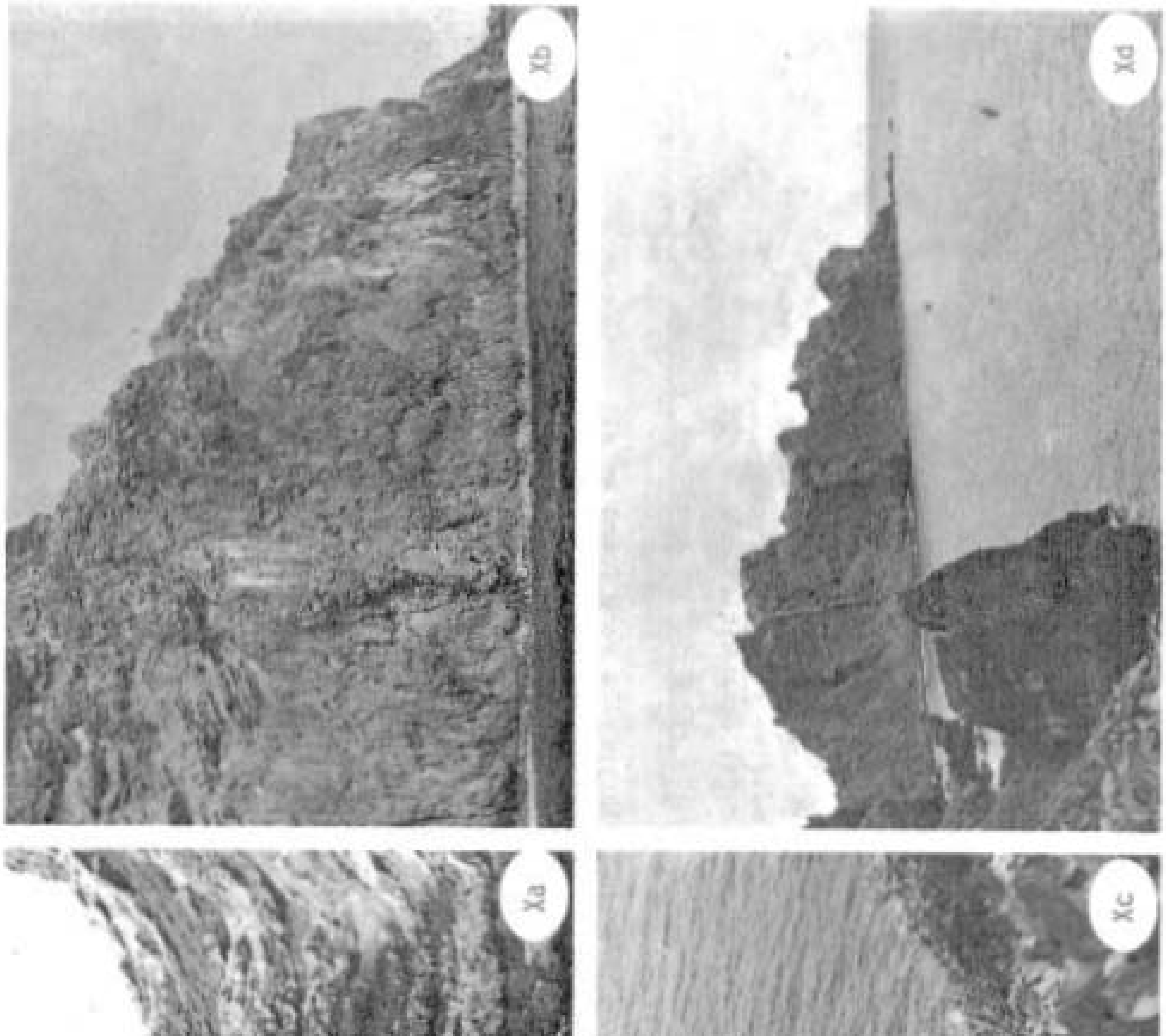

Xb
Xd
Xa
Xc

PLATE XI

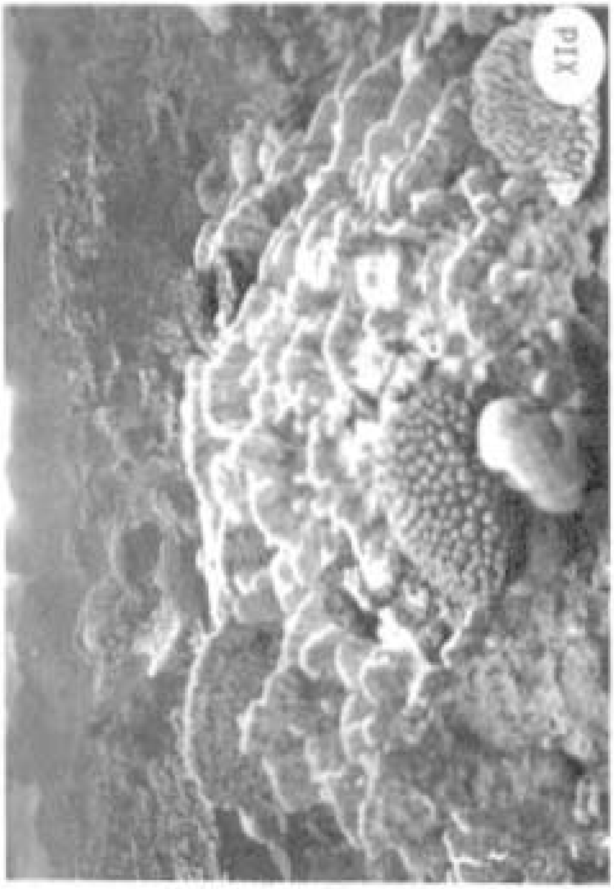
a. Acropora irregularis is a predominant species in shallow water off West Island. (S. Neudecker)

b. A colony of Porites lutea covers a large basaltic boulder off the northern end of East Island. Similar massive Porites colonies predominate most of the crater lagoon coral communities. (S. Neudecker).

c. Large foliaceous stands of Millepora platyphylla were found at all sites which had coral coverage. This colony was photographed off the northern end of East Island (Site 1). (S. Neudecker)

d. A coral community in shallow water (~1.5m) off West Island. Acropora humilis (foreground), Millepora platyphylla and Acropora irregularis (upper right) were common at this site. (S. Neudecker)


XIb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XIa

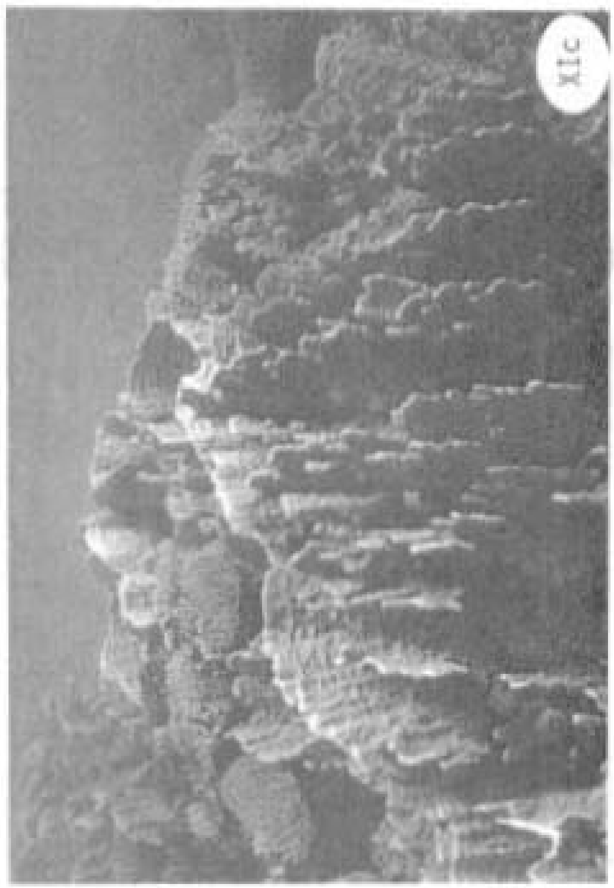
XIc

PLATE XII

a. The lagoon slope (to -12m) off the northern end of East Island was predominated by massive Porites species. Acropora, Astreopora, and Pocillopora were common. (S. Neudecker)

b. Several Kyphosus cinerascens swim along the lagoon slope off the northern end of East Island. (S. Neudecker)

c. Large colonies of Porites (Synarea) predominate in shallow lagoon water at the north end of West Islands.

d. Large aggregations of Colobocentrotus mertensi in the intertidal area at the west end of North Island.

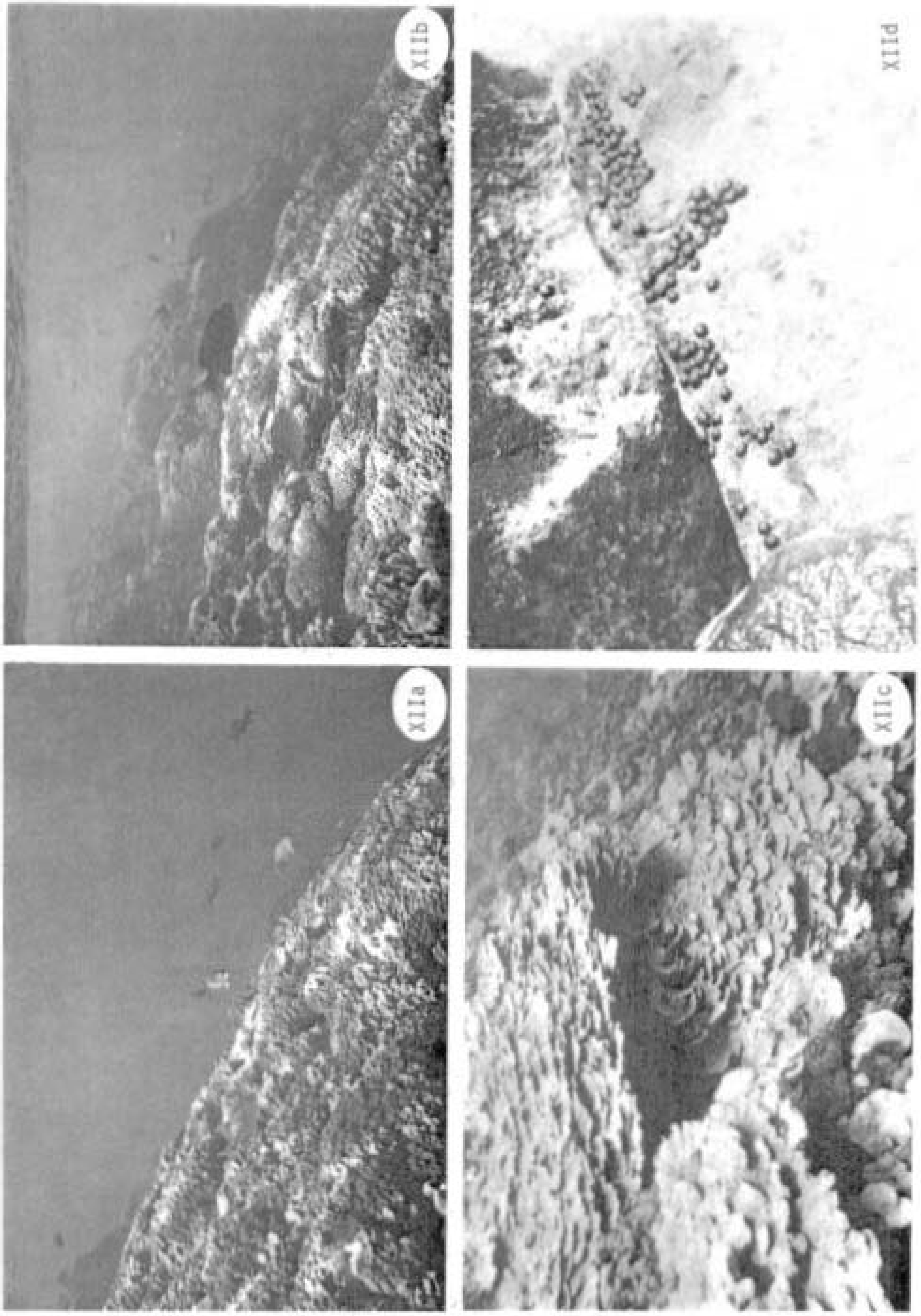
XIIa
XIIb
XIIc
XIId

PLATE XIII

a. Brown booby nesting at ridge of East Island; North Island is in the background.

b. Brown booby juvenile in nest at ridge of West Island.

c. Endemic Phyllanthus marianus.

d. Low growth composed primarily of Capparis and Ipomoea with scatterred Cyperus javanicus.


XIIIa


XIIIb


XIIIc


XIIId

PLATE XIV

a. Ruins of fish processing plant at northern end of East Island; water catchment container at right, steaming pots toward left.

b. Ruins of three-story weather station at summit of East Island.


XIVb


XIVa