

NOTES ON THE DISTRIBUTION OF RED ALGAE (RHODOPHYTA) ON THE  
CORAL REEF OF PARI ISLANDS, SERIBU ISLANDS

by

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ABSTRACT

Many species of red algae are economically important for their carrageenan contents. Since May 1974 to June 1975 an intensive survey on their distributions have been carried out on the fringing reef of Pari Islands, Seribu Islands.

Thirty five species of Rhodophyta have been identified and their species composition and relative importance as compared to Phaeophyta and Chlorophyta have been studied.

Environmental factors, such as bottom type and seasonal influence on their distribution, emphasized in the discussion.

Further studies on inventory and the distribution of these algae will be continued particularly in support of the culture experiments for some of the species.

INTRODUCTION

Some species of red algae are economically important as supplementary food and as raw materials for industries producing carrageenan for cosmetics, pharmacies, etc.

The inventory of algae in some areas is important for further studies on their taxonomy, morphology, and distribution. The data obtained is also necessary to support marine culture experiments. Marine culture helps improving natural stock which is being depleted by environmental factors.

Some investigators have been working on the same subject with different methods such as collecting, transecting, and standing crop assessing. TAYLOR (1937) and DAWSON (1955) made their studies in USA; ZANEVELD (1955) and SURJODINOTO & PARDANINGSIH (1964) in Indonesia, TSUDA (1972) in the Caroline Island, VARMA & RAO (1962) in India, and DOTY (1970) in the Philippines.

The economically important algae in Pamban area, India, were confined to shallow regions, generally to depths less than 2—3 meters and practically none of the weeds are found deeper than 7 meters. They are distributed along the coral beds or on the rocky substratum covered with a thin layer of sand (VARMA & RAO 1962).

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Thirteen genera of edible and commercial algae were recorded from the coral reef of Pari Island, five of which were red algae (SURJODINOTO & PARDANINGSIH 1964)

Some species of Rhodophyta are depositors of calcium carbonate *i.e.* calcareous algae like *Liagora* sp., *Peyjssonelia* sp. and other species of Corallinaceae (DAWSON 1966)

SUKARNO (1975) found that algae formed the dominant biota on the reef flats of Ayer Island, growing attached on rubbles or hard substrate and in the algal regions on the outer edges of the reef, where groups of Scleractinian corals were rare.

#### MATERIALS AND METHODS

Pari Islands (05°50'40" - 05°52'50" S Lat., 106° 34' - 106° 38' E Long.) is a group of reef islands, consisting of five islands (Pari Isl., Tengah Isl., Kongsu Isl., Burung Isl., and Tikus Isl.) and seven lagoons (Besar, Ciaris, Koanji, Labangan pasir, Soabesar, Buntu, and Kurungan). Encircling these islands is a barrier reef with six channels that provide water circulation to the reef flats. The reefs form a "pseudo atoll" of 15,430,824.76 square meters, with tide pools and tidal zones which occupies an area of 11,231,330.77 square meters, and 3,367,324.35 square meters of lagoons (SURYODINOTO 1967).

The difference between low and high water in this area is about one meter. Most of the reefs (sand flats) are not submerged during low tides except the moat with rubble substrates (Figs. 1, 2, and 3).

The data were obtained by observation, collection (made during December 1973 to May 1975), transect measurements (made during July 1972 to June 1975), and by standing crop determinations (made during August 1974 to January 1975). In the last case, transect lines were stretched at north-south direction, parallel to and at one to two hundred meters distance from one another. Observations were made by counting the number of species and the number of specimens for each species of algae found within one square metre areas along the transect lines. The distance between one area and the other is ten metres. Standing crop determinations were based on the wet weight of each algal species harvested per square meter. The samples were placed in 70% alcohol as liquid preservations and were also preserved as dry herbaria.

NOTES ON THE DISTRIBUTION OF RED ALGAE

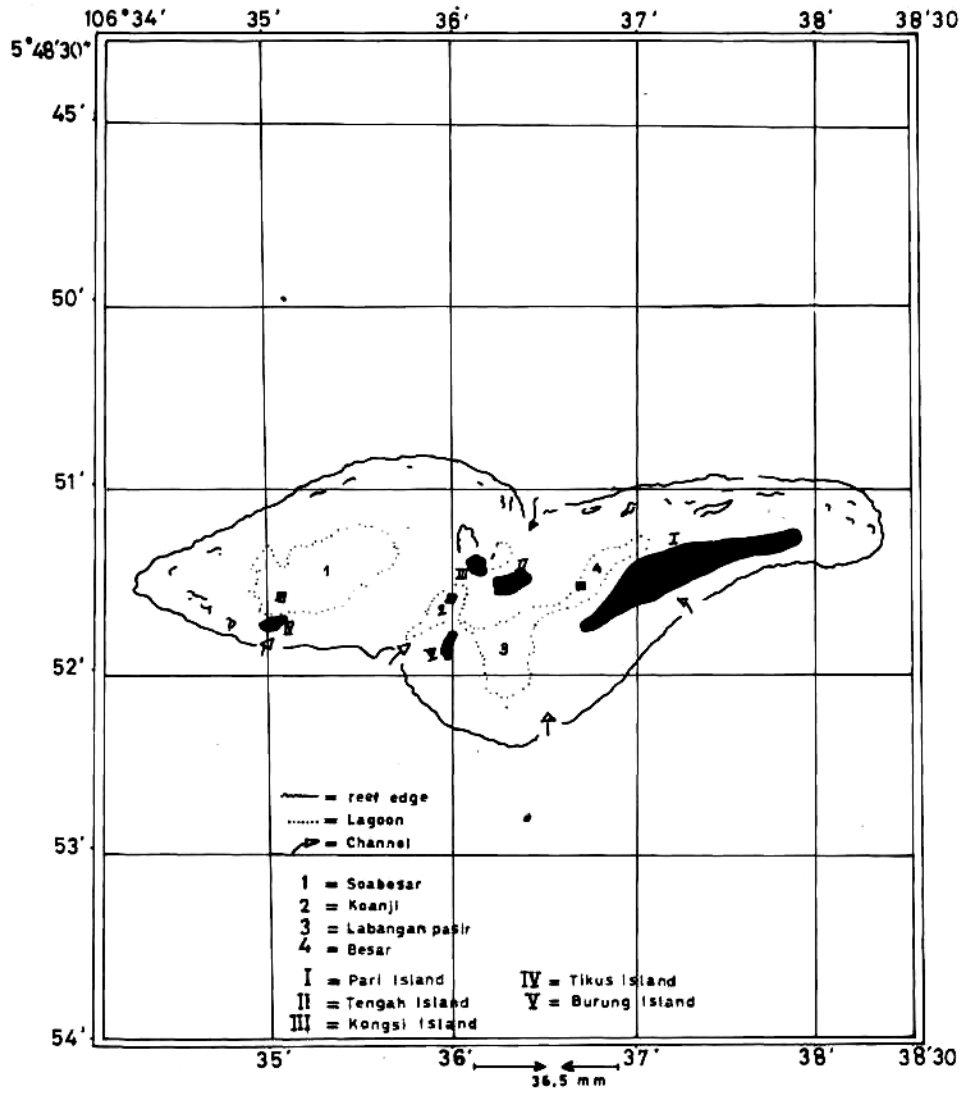


Figure 1. Pari Islands group

WANDA SURJANA ATMADJA

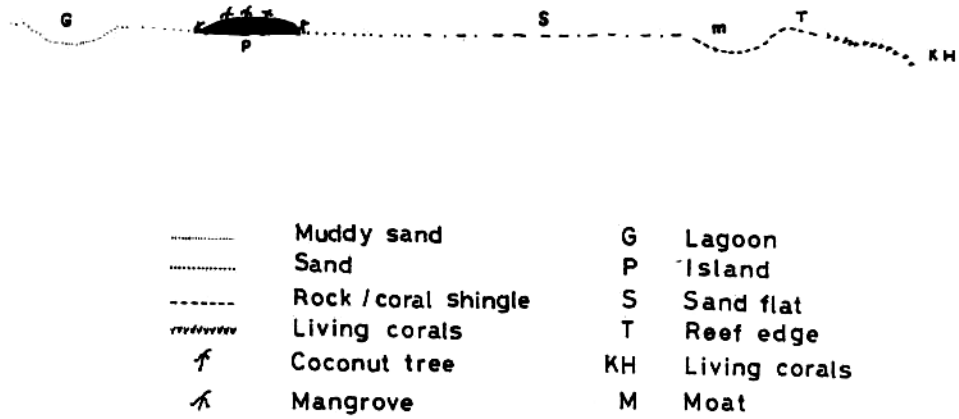


Figure 2 : Cross section of typical bottom area in the coral reef of Pari Island.

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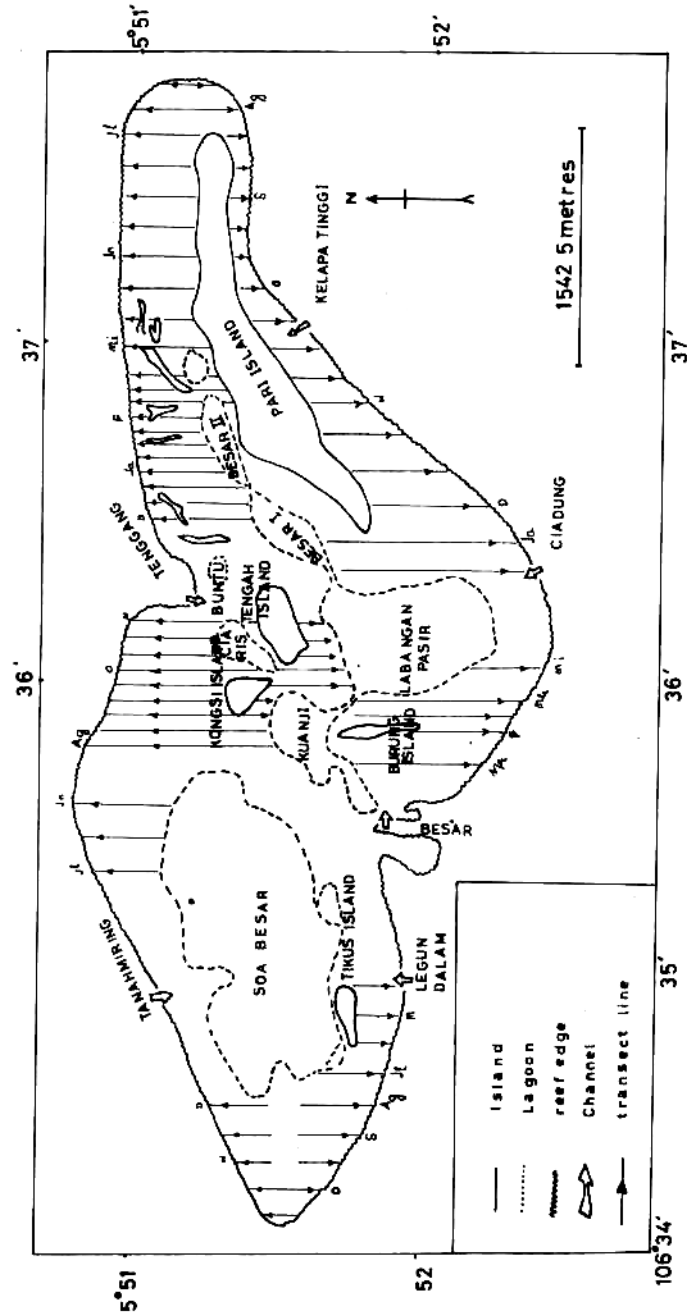


Figure 3. Topographical feature of Pari Island

WANDA SURJANA ATMADJA

RESULTS

1. OBSERVATIONS AND COLLECTION

Thirty five species of red algae (Rhodophyta) are identified from the collections (Table I).

Table I. List of the red algal species from the coral reef of Pari Island

Ceramiales	<i>Halimena</i> sp.
Rhodomelaceae	<i>H. durvillaei</i> BORY
<i>Acanthophora</i> LAMOUROUX	Gigartinales
<i>Acanthophora dendroides</i> HARV	Gracilariaceae
<i>A. spicifera</i> (FAHL) BOERG	<i>Gracilaria</i> GREVILLE
<i>Chondria</i> C. AGARDH	<i>Gracilaria</i> sp.
<i>Chondria dasyphylla</i> (WOODW) C.AG.	<i>G. arcuata</i> ZAN.
<i>Laurencia</i> LAMOUROUX	<i>G. eucheumioides</i> HARVEY
<i>L. parvipapillata</i> TSENG	<i>Corallopsis</i> GREVILLE
<i>L. obtusa</i> (HUDS) LAMX	<i>Corallopsis salicornia</i> (MART) GREV.
<i>Polysiphonia</i> GREV.	Soliriaceae
<i>Polysiphonia flexicaulis</i> (HARV) COLL.	<i>Eucheuma</i> J.AG.
<i>Polysiphonia</i> sp.	<i>Eucheuma spinosum</i> (LINN) J.AG.
Ceramiaceae	<i>E. edule</i> (KUTZ)
<i>Ceramium</i> ROTH	-----
<i>Ceramium deslongchampii</i> CHAUVIN.	Hypneaceae
Delesseriaceae	<i>Hypnea</i> LAMX
<i>Zellera</i> v. MARTIN	<i>Hypnea nidifica</i> J.AG.
<i>Zellera tawallina</i> v. MARTIN	<i>H. cenomyce</i> J.AG.
Cryptonemiales	<i>H. chordareae</i> KUTZ
Corallinaceae	<i>H. cervicornis</i> J.AG.
<i>Amphiroa</i> LAMOUROUX	<i>H. choroides</i> LAMX
<i>Amphiroa fragillissima</i> (LINN) LAMX.	<i>H. musciformis</i> KUTZ
<i>Amphiroa foliacea</i> LAMX	<i>H. nidulans</i> SETCH
<i>Goniolithon</i> FOSLIE	Nemalionales
<i>Goniolithon</i> sp.	Rhizophylidaceae
<i>Jania</i>	<i>Chondrococcus</i> KUTZING[
<i>Jania</i> sp.	<i>Chondrococcus hornemanii</i> (MERT) SCHM.
<i>Lithothamnion</i> PHILIPPI	Helminthocladiaceae
<i>Lithothamnion</i> sp.	<i>Galaxaura</i>
Gelidiales	<i>Galaxaura</i> spp.
Gelidiellaceae	<i>Liagora</i> LAMOUROUX
<i>Gelidiella</i>	<i>Liagora ceranoides</i> LAMX
<i>Gelidiella</i> sp.	Chaetangiaceae
Grateloupiaceae	<i>Scinae</i> BIVONA
<i>Halimena</i> C. AGARDH	<i>Scinae</i> sp.

## NOTES ON THE DISTRIBUTION OF RED ALGAE

Algal growths are generally found on rocky substrates or dead corals which are permanently submerged at the moat of reef.

*Laurencia*, *Hypnea*, and *Acanthophora* are found on sand flats. At the slopes of reef, *Galaxaura*, *Liagora*, and *Zellera* are collected. *Halymenia durvillae* and *Hypnea* sp. are found attached on living corals. The genera *Amphiroa*, *Lithothamnion*, and *Goniolithon* (Corallinaceae) generally grow on live or dead coral beds. *Amphiroa* is also found on the sea grass areas at the edge of lagoons.

Vegetation group of *Laurencia obtusa* is frequently found on dead coral fragments *i.e.* at the southeast of Burung Island.

Some species of sea grass (Spermatophyta) like *Enhalus acoroides*, *Thalassia* sp., and *Halophyla* spp. are found distributed in this area especially on the edge of lagoons and sand flats..

### 2. TRANSECTS

A total number of 73 transect lines were observed covering 3,098 square meters. From the transect lines individual and group algae were counted. Table II and III shows the quantities, distribution and dominance of algal groups.

#### **The Area of Tikus Island**

In this area red algae are found more abundant and more varied on rocky substrates than on sandy habitats. The amount of Rhodophyta is smaller than Phaeophyta (*Sargassum* spp., *Padina* spp., and *Turbinaria* spp.) and Chlorophyta (*Caulerpa* spp. and *Halimeda* spp.). Some of the species such as *Laurencia* spp., *Acanthophora* spp., *Hypnea* spp., and *Gracilaria* spp. are found in greater number than *Eucheuma* spp., *Amphiroa* spp., and *Galaxaura* spp.

#### **The Area of Pari Island**

In this area red algae (Rhodophyta) are smaller in number than Phaeophyta. *Acanthophora* and *Hypnea* (Rhodophyta); *Sargassum* and *Padina* (Phaeophyta); *Caulerpa* and *Halimeda* (Chlorophyta) are frequently found on sandy substrates. Besides the algae mentioned above, *Laurencia* are also found on rocky substrates. At certain areas *Eucheuma spinosum* is found in a relatively great number.

#### **The Northeast Area of Burung Island**

Phaeophyta in this area dominate over other algae. The important algae are *Padina*, *Sargassum*, *Laurencia*, *Acanthophora*, *Gracilaria*, and *Hypnea*. *Caulerpa* and *Halimeda* are the most common algae of the Chlorophyta.

## WANDA SURJANA ATMADJA

Table II. Distribution of algal numbers obtained from transect

Locality	Algae	Habitats and quantities					
		sand		rock		mud	
		ind.	+	ind.	+	ind.	+
1. Kongsu Isl. Jul. '72 – Jun. '73	Rhodophyta	840	59	547	164	35	–
	Phaeophyta	1420	67	745	56	28	–
	Chlorophyta	713	77	471	124	33	–
		2973	202	1763	344	96	–
2. Pari Isl. Jul. '73 – Jan. '74.	Rhodophyta	530	25	378	78	2	–
	Phaeophyta	715	22	1017	87	–	–
	Chlorophyta	405	17	409	62	8	–
		1650	64	1804	227	10	–
3. Tikus Isl. Feb. '75 – Jun. '75.	Rhodophyta	72	15	130	29	–	–
	Phaeophyta	256	19	274	23	–	–
	Chlorophyta	138	10	97	44	–	–
		467	44	501	96	–	–
4. Burung Isl. Feb. '74 – Jan. '75.	Rhodophyta	100	10	11	9	1	–
	Phaeophyta	328	20	28	9	–	–
	Chlorophyta	91	7	11	3	–	–
		519	37	50	21	1	–

Dominant species in :

1. *Acanthophora* spp., *Euclima spinosum*, *Padina* spp. and *Sargassum* spp.
2. *Acanthophora* spp., *Laurencia* spp., *Sargassum* spp., *Turbinaria* spp., *Padina* spp., *Caulerpa* spp., and *Halimeda* spp.
3. and 4. *Acanthophora* spp., *Laurencia* spp., *Sargassum* spp., *Padina* spp., *Caulerpa* spp., and *Halimeda* spp.-

### The Area of the Kongsu Island

Concentration of algae are found predominantly on rocky habitats. Most of the *Acanthophora*, *Euclima*, *Caulerpa*, and *Halimeda* grow on this habitat. Of the Phaeophyta, *Padina* is found distributed on sandy and rocky habitats. Next important members of Phaeophyta are *Sargassum* and *Turbinaria*.

### 3. STANDING CROPS

Measurements of standing crops from 15 stations shows that wet weight percentage of red algae varies from 18 to 100%. In the area of *Euclima spinosum* populations, the variations are between 18 to 45%.

## NOTES ON THE DISTRIBUTION OF RED ALGAE

Table III. The number distribution and dominance of benthic marine algae obtained from transect

Algae	Habitats and quantities					
	Sand		rock		mud	
	ind.	+	ind.	+	ind.	+
Rhodophyta	1542	109	1066	280	38	-
Common species						
<i>Acanthophora</i> spp.*	961	61	389	137	29	-
<i>Laurencia</i> spp.*	144	17	134	66	4	-
<i>Hypnea</i> spp.	140	13	38	21	2	-
<i>Gracilaria</i> spp.	80	2	133	17	-	-
Phaeophyta	2719	128	2064	175	28	-
Common species						
<i>Sargassum</i> spp.*	430	30	597	77	-	-
<i>Padina</i> spp.*	1670	69	754	37	27	-
<i>Turbinaria</i> spp.	304	11	557	32	-	-
<i>Dictyota</i> spp.	149	7	158	29	-	-
Chlorophyta	1347	110	988	233	41	-
<i>Caulerpa</i> spp.*	403	72	448	178	16	-
<i>Halimeda</i> spp.	743	30	369	42	15	-
<i>Ulva lactuca</i>	59	1	58	1	-	-

ind. individual  
 + more than 10  
 \* dominant

Communities of red algae reaching 100% are found to consist of *Laurencia* spp. only. The average red algae standing crops is 49.60% (Table IV).

#### 4. EPIPHYTIC ALGAE

Red algae are also found on rafts used for culture experiment of *Eucheuma spinosum* in the lagoons and also as epiphytes on many thalli of other algae like *Sargassum* spp. Those are *Acanthophora spicifera*, *Laurencia*, *Hypnea*, *Jania*, *Ceramium*, and *Polysiphonia*. These algae are generally present on those rafts after one or two months following the beginning of cultivation experiments.

## WANDA SURJANA ATMADJA

Table IV. Wet weight composition per square meter obtained from standing crop measurements

Locality	Algae	Time and percentage of wet weight				
		31/8-74	1/9-74	29/9-74	29/9-74	27/1-75
Kongsi Island.	Rhodophyta	43.40	26.81	36.00	63.44	91.02
	Phaeophyta	28.66	67.57	29.80	19.78	14.91
	Chlorophyta	9.86	1.15	13.44	15.31	17.79
Dominant species :		<i>Acanthophora</i> spp., <i>Eucheuma spinosum</i> , <i>Sargassum</i> spp. and <i>Halimeda</i> spp.				
Tikus Island.		28/8-74	24/9-74			
	Rhodophyta	68.01	9.85			
	Phaeophyta	10.28	4.78			
	Chlorophyta	18.44	58.37			
Dominant species :		<i>Laurencia</i> spp., <i>Hypnea</i> spp. and <i>Acanthophora</i> spp.				
Burung Island.		3/9-74	10/9-74	10/9-74	10/9-74	
	Rhodophyta	51.03	82.08	100.00	67.42	
	Phaeophyta	32.58	14.80	—	31.28	
	Chlorophyta	3.22	3.00	—	1.30	
Dominant species :		<i>Laurencia</i> spp., <i>Hypnea</i> spp. and <i>Sargassum</i> spp.				
		2/9-74	7/1-75	13/1-75	7/1-75	
	Rhodophyta	18.72	45.36	48.18	25.13	
	Phaeophyta	28.67	14.13	15.83	35.95	
	Chlorophyta	22.20	13.06	8.23	13.66	
Dominant species :		<i>Acanthophora</i> spp., <i>Eucheuma spinosum</i> , <i>Gracilaria</i> spp., <i>Sargassum</i> spp., <i>Turbinaria</i> spp., and <i>Halimeda</i> spp.				

## 5. ENVIRONMENTAL FACTORS

## a. Biological factors

Generally some marine animals like *Synapta* sp. and *Bohadschia* sp. are found amongst algal vegetations in relatively great numbers. Animals like *Lynkia* sp., *Lambis-lambis*, and *Lambis chiragra-chiragra* are also found but in smaller numbers. On sandy habitats *Archaster typicus*, *Laganum* sp., *Deadema* sp., *Microthele nobilis*, *Bohadschia* sp., *H. scabra*, *Cerithium vertagus*, *Cypraea* sp., *Strombus* sp., and some species of bivalves such as *Venus purpurea* are found.

## b. Physical factors

Air and water temperatures vary from 26.50° — 33°C, salinities 30-32‰, 02 2.50 - 4.50 cc/l and pH 6-8.

## NOTES ON THE DISTRIBUTION OF RED ALGAE

### DISCUSSION

Thirty five species of red algae have been recorded from this area. This is much richer in species than that recorded by COURTENAY (1974) from Lauderdale, Florida (11 species) and by DOTY (1970) from some areas in the Philippines (16 species) and still richer than that recorded by TSUDA & BELK (1972) from Caroline Island (32 species). But as compared to the 555 species recorded from Indonesian waters by VAN BOSSE (1928), the 320 species from around north Wellington Island (ADAMS 1972) and 63 species from the waters of the Gulf of Mexico, (STADINGER & BREEDVELD 1971) the record from Pari Island is certainly not yet sufficient. From 54 species of useful algae from Indonesian waters (SUGIARTO 1968), 21 species are red algae and about half are known to this area.

The great species variations found here are possibly due to environmental conditions which are agreeable for red algal growth. The red algae are relatively adapted to shallow regions (FELDMAN 1951). Based on their substrates, the red algae in this area are generally "ephyllithes" but are also found as "epiphytes" such as *Laurencia*, *Hypnea*, and *Acanthophora spicifera*. Exposure to direct sunlight on sandy habitats are tolerated by *Acanthophora spicifera* and *A. dendroides*. Some red algae such as *Amphiroa* sp. grow on seagrass areas, or attached to living corals such as *Halymenia durvilleae* and *Hypnea* sp. *Galaxaura* spp. generally grow on reef slopes. The red algae of the area can grow perennially and annually.

Visual observations show that the growth of thalli of some species of red algae generally occurs in August, September, and October. Further attention will be paid on this matter in the next study.

### CONCLUSIONS

From the investigation that had been done in the coral reef of Pari Island, the following results are obtained :

1. Thirty five species of red algae have been identified from the collections obtained from the coral reef of Pari Island.
2. The species variations and the percentage of wet weight per square meter of the red algae were greater in comparison to brown and green algae.
3. Generally the algae grows in great numbers as "ephyllithes" at moats of the reef than on sandy or muddy habitats.
4. The quantities and qualities of growth are possibly related to environmental factors of this area.

WANDA SURJANA ATMADJA

5. *Laurencia* spp. are found in single populations whereas *Eucheuma spinosum* is nearly always found in mixed populations.
6. The growth of algae of the area are apparent as perennial or annual.

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NOTES ON THE DISTRIBUTION OF RED ALGAE

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