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STUDIES ON PLANKTON, PRIMARY PRODUCTION AND FISH IN THE INNER BRUNEI BAY

by

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INTRODUCTION

The Brunei Bay is a relatively shallow enclosed water area (Figure 1), approx. 45 x 45 km in size. Depth figures normally range between 30 and 40 meters. The bay is influenced by a number of rivers which discharge into the area, the largest being Padas in the north and Limbang in the south. The annual mean flow of Padas is estimated at 200 m^3 per sec and the maximum over 1550. The rivers contribute with large quantities of sediment into the bay, and this sediment is covering the seabed and cause turbidity of the water. The total amounts of suspended solids brought to Brunei Bay from the river Padas has been measured at 2000—3000 tos per day or about 1 million ton per year. The vegetation in the area north, east and south of Brunei Bay consists'of primary and secondary rain forest, rubber plantations and other crop, and mangrove swamps. In 1982-1983 large areas of tropical forest on Borneo was affected by fire. It has been estimated that, in East Kalimantan only, some 3,5 million hectares of forest were destroyed. The fires also affected close to 1 million hectares of tropical vegetation in western Sabah (MALINGREAU *et al* 1985) and it seems probable that there have been indirect effects also in the marine environment due to thess fires.

An area in the eastern central portion, the Gunong Lumako Forest Reserve, is since the last 5 years subject to extensive forestry operations involving systematic clear-cutting and plantation. This area is also being industrialized, involving for example the construction of a wood—, pulp- and papermill complex, the construction of an ocean harbor and various other infrastructures. The study reported here was carried out in 1984 and 1985 to provide some basic information on the marine ecosystems of the inner Brunei Bay. The present results cover studies of the diversity and abundance of the plankton, primary production, and fish fauna of the inner Brunei Bay. A separate report covers the state of the coral reefs in the area (LINDEN *et al*, 1988), and another report various physico-chemical parameters of the water and sediment (in preparation). The only plankton study available from Brunei Bay is the result of a preliminary study of the species composition of zooplankton carried out by MOHAMED *et al* (1984). Also with regard to the South China Sea in general, few studies have been reported. However, some baseline work has been carried out in the Straits of Malacca and along the east coast of Peninsular Malaysia (CHUA & CHONG 1973, CHU A1984).

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In the present study qualitative and semi-quantitative samples of phyto— and zooplankton were collected in Brunei Bay during November-December 1984 and April 1985. In addition, the amount of chlorophyll a was determined and the primary productivity was studied using the ^{14}C technique.

No previous results of scientific investigations of the fish fauna of Brunei Bay are available. However, a checklist of marine fishes of West Sabah, based on collection made in March 1974, have been published by CHUA& CHAW (1978). In order to study the fish fauna of the area in Brunei Bay a number of fishing efforts using survey nets and a beach seine net were conducted in November—December 1984.

METHODS

Phytoplankton were sampled using a standard phytoplankton net (mesh size : 50 um, diameter : 15 cm). One vertical haul from the sea bed to the surface was taken at each station. The samples were preserved in neutralized 4% formaldehyde solution. Qualitative and semi-quantitative analysis were carried out using an inverted microscope.

For the determination of chlorophyll a samples of 500 ml of sea water collected at the surface and in the deep water were filtered through 0.45 *u* fibreglass filters in the field. The filters were stored in a freezer until they were analyzed for chlorophyll a according to standard methods.

Primary production was measured using ^{14}C-technique according to standard methods. Water samples were incubated in glass flasks for 3 to 5 hours at 5 different depths (usually 0.5, 5, 8, 12 m and 0.5 m above the bottom). Dark bottles were incubated at 0.5 m and at the largest depth. Four *u*Ci of carrier free $NaH^{14}CO_3$ were added to all bottles. After incubation the samples were acidified and the samples were aerated for 20 minutes. Ten ml of the samples were transferred to scintillation vi&ls and counted in instagel (Packard Instruments) in an Intertechnique SL 40 liquid scintillation counter. The uptake of carbon was calculated according toGARGAS(1975).

Samples of zooplantkon were obtained by vertical net hauls from bottom to surface, using a Unesco WP-2 net with 90 *u*m mesh size. The samples were preserved in 4% formaldehyde solution. Counting and determination of groups were performed using an inverted microscope.

For fish sampling standard survey nets of 36 m length, 1.5 m height, divided into 12 sections, each with a length of 3 m with mesh size varying from % to 3 inches were used. Ten nets were utilized each time. Fishing was carried out in the day during 2½ to 5 hours, or through the night during 13 hours. The stations are shown in Figure 2.

For nearshore fishing a beach seine net measuring 28.8 m in length and 1.5 m in height with a mesh size of 6 mm was used. At each station 4 to 7 shootings of the net were conducted, each covering an area of approx. 2.500 m^2. At each occasion the shootings were carried out around noon and the stations are shown in Figure 2.

RESULTS AND DISCUSSION

Phytoplankton

At least 78 species of phytoplankton were recorded during the two sampling periods. The results are shown in Table 1. In November—December some 71 species were obtained, while in April some 48 species were recorded. Also with regard to abundance, higher figures were noted in November—December compared to April. The dominating genera in November—Desember were diatoms such as *Bacteriastrum, Chaetoceros* and *Rhizosolenia* These are large organisms which occurred in high abundance. In April these genera were also noted but, with few exceptions, much less abundant than five months earlier. Instead blue-green algae *(Oscillatoria)* dominated all samples collected in April. This group was only found occasionally during November—December.

Hence, larger species diversity and abundance were recorded in November—December compared to April. The situation in April could indicate that lower concentrations of nutrients were available, resulting in lower phytoplankton activity. These observations were confirmed in the studies of chlorophyll and primary production (see below).

The results of the chlorophyll a analysis, shown in Table 2, indicate two to three times higher figures during November—December compared to April. These results are in agreement with the results of the studies of the species diversity and abundance reported above.

The primary production measured as C^{14}-uptake was 3 times higher in November-December compared to April (Table 3). If a 12 hr daylight period is assumed, the autumn value is on average slightly over 550 mg C m day , and the spring value slightly over 150 mg C. Assuming that the year is divided into autumn and spring production, the integrated production on the whole year may be calculated as 100—150 g C $m^{\sim 2}$. Such figures are in general in accordance with what would be expected from coastal tropical areas. RYTHER (1969) reports values in that range. However, the difference in primary production between autumn and spring, may seem remarkable for a tropical area. This difference is possibly at least partly determined by the loss of nutrients and differences in turbidity due to land run-off. The annual precipitation in the area approaches 4000 millimeter/year, and the most pronounced rainy period is October to January.

Zooplankton

The results of the studies of the zooplankton population are shown in Tables 4 and 5. Generally the most common group is crustaceans with copepods frequently being abundant. Shrimp larvae were recorded in most samples. Tunicates and chaetognates appeared to be slightly more common in April compared to November-December. Otherwise no obvious differences could be observed between the two sampling periods.

Fish

The results of the fishing using survey nets are shown in Tables 6 to 10. In total some 54 species were caught (Table 6). The largest number of species and total weight were obtained when fishing was carried out through the night (although it should be remembered that at this occasion fishing was carried out two to three times longer than during the day). The most abundant groups (total number) were sardins (Clupeidae), ponyfish (Leiognathidae) and catfish (Ariidae). Some species were obtained during the night only; such as catfish, snook (Centropomidae) and croakers (Scianidae). Triggerfish (Balistidae) were caught during daylight only. By weight the most important groups were catfish, sardins and herrings, therapons (Teraponidae), spadefish (Ephippidae) and rays (Rajidae).

The results of the sampling using theseine net are shown in Tables 11 to 15. Some 42 species were caught using the beach sein (Table 11). The most common groups were juveniles of mullets (Mugilidae), snooks, and silversides (Atherinidae). By weight the most important groups were tongue fish (Cynoglossidae) and flounder (Bothidae).

Despite the relatively limited effort, the study indicate that the Sipitang area is inhabited by a diverse fish fauna. Many of the approximately 240 species reported by CHUA and CHAW (1978) for West Sabah occured in the area. Several of the species obtained in the present study are of high commercial importance (jacks) and cavalla had a retail price of 6.50 to 7.30 Ringgit* kg^{-1} in Sipitang in 1983; the corresponding figure for mackerel was 5.60 to 7.20 Ringgit kg^{-1}). In addition it is also clear from the shallow water samplings .that these areas function as nursery and feeding areas for junveniles of commercially important species. Studies similar to the present one were carried out on the east coast of Peninsular Malaysia (TAN, 1984). Although the methods used were not exactly the same as those used in the present study, the results indicate that much larger number of specie^ and larger quantities of young fish were obtained in the present study compared to what was found in the study at Peninsular Malaysia.

In conclusion, the present study has provided some basic information on the marine ecosystem of Brunei Bay. The investigation has shown a large variation in plankton diversity, biomass and productivity during the year. In November—December more species were present, the chlorphyll content was higher and the primary productivity higher than during April. This difference is likely to be at least partly related to the increased flush-out of nutrients from land during the rainy season. Furthermore the study has shown a rich fauna of fish in a relatively limited area.

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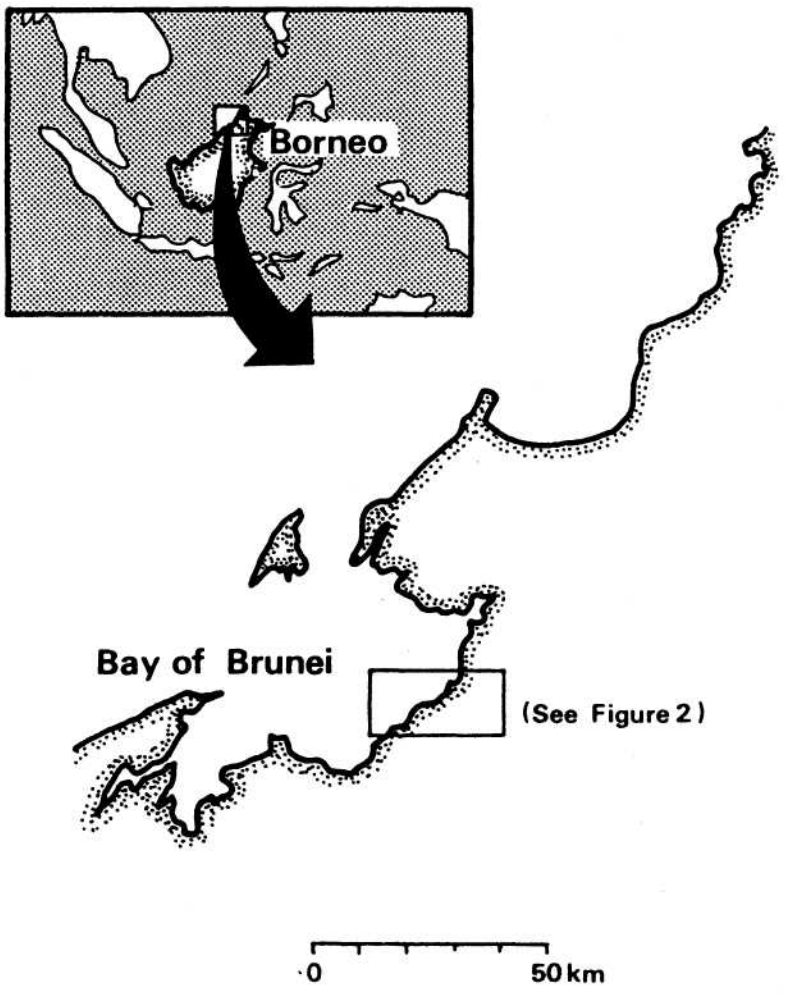

Figure 1. Location of Brunei Bay

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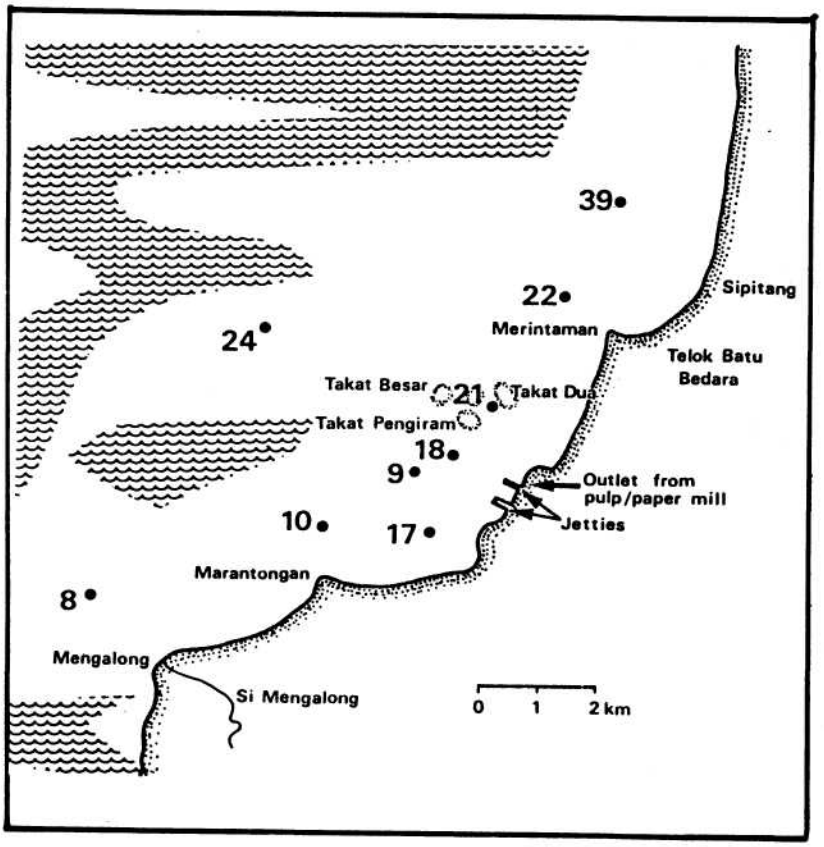

Figure 2. Location of station in The Brunei Bay

Tabel 1. Phytoplanton caught in Brunei Bay in November-December 1984 and April 1985.

1 = occasional 2 = abundant 3 = very abundant

	N	November–December 1984					April 1985			
DIATOM **Station :**	16	10	17	22	9	21	22	18	39	22
Asterionella glacialis	–	1	1	–	–	–	–	–	–	1
Asteromphalus flabellatus	–	–	–	1	–	–	–	–	–	–
Bacteriastrum comosum	2	2	2	1	–	–	–	–	–	–
hyalinum	3	3	–	3	2	1	–	1	–	–
varians	3	–	3	3	–	2	2	–	–	1
Biddulphi sinensis	1	1	–	1	1	–	–	1	–	1
Cerataulina pelagica	1	–	–	–	–	1	–	–	–	–
Chaetorecos affinis	2	2	2	2	1	1	–	1	1	1
borealis	–	–	–	–	1	1	–	–	–	–
brevis	1	1	–	–	–	2	3	–	1	1
coarctatus	–	–	–	–	–	–	–	–	1	–
compressus	–	–	–	1	–	1	–	–	–	–
constrictus	–	1	–	–	–	–	–	–	–	–
curvisetus	1	–	–	–	–	1	–	–	–	–
diadema	1	1	–	–	–	1	1	1	1	–
didymus v. anglica	1	–	–	–	–	–	–	–	–	–
distans	2	2	–	2	2	1	–	–	1	1
lorenzianum	1	1	2	1	–	–	–	–	–	–
paradoxum	2	2	1	2	1	1	–	–	–	–
peruvianum	1	1	1	1	–	–	–	–	1	1
pseudocurvisetus	–	–	–	1	1	–	–	–	–	–
Climacodium frauenfeldianum	–	–	–	1	1	1	1	1	1	1
Corethron criophilum	1	1	–	1	1	–	–	–	–	–
Coscinodiscus spp.	–	1	–	–	–	1	–	–	–	–
Ditylum sol	–	–	–	–	1	1	–	1	1	1
Eucampia zodiacus	–	–	1	–	–	–	–	–	–	–
Guinardia flaccida	–	1	–	–	1	1	1	–	1	1
Hemiaulus hauckii	–	–	–	–	–	–	–	1	–	–
Lauderia borealis	–	1	–	–	–	–	–	–	1	–
Leptocylindrus danicus	1	–	–	–	1	1	–	–	1	–
mediterraneus	1	–	–	1	–	1	–	–	–	–
Nitzschia closterium	–	–	–	–	–	–	1	–	–	–
longissima	–	–	1	–	–	–	–	–	–	–
serata	–	1	–	–	–	1	–	–	–	–
spp.	–	–	–	–	–	–	1	1	–	–
Rhizosolenia alata v. indica	–	1	–	–	–	1	–	–	–	–
bergonii	1	–	–	–	–	–	–	–	–	–
calcar-avis	1	1	1	1	1	–	–	–	–	–
formosa	–	1	–	–	–	–	–	–	–	–
fragillissima	1	1	–	–	1	–	1	–	–	–
imbricata	–	1	–	–	1	–	–	–	–	–
ghuketensis	–	1	–	–	–	–	–	–	–	–
robusta	–	–	1	–	–	–	–	–	–	–
stolterfothii	–	1	1	–	1	1	–	–	–	1

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Schroderella delicatula	–	1	–	–	–	–	–	–	–	–
Skeletonema costatum	1	1	–	–	1	–	1	1	–	–
Thalassionema nitzschioides	1	1	1	1	1	1	1	–	1	–
Thalassiosira spp.	1	1	1	–	1	–	1	–	1	–
Thalassiothrix longissima	1	1	1	–	–	–	–	–	–	–
DINOFLAGELLATES										
Ceratium breve	–	–	–	–	–	–	1	–	1	1
furca	–	1	–	1	1	1	1	1	1	1
fusus	1	1	–	–	1	1	1	1	1	1
macroceros	–	–	–	–	–	–	1	–	1	–
massiliense	1	1	1	–	–	1	–	1	–	1
trichoceros	1	1	–	1	–	1	1	–	1	1
tripos	–	1	1	1	–	–	–	–	1	–
Dinophysys caudata forma pedunculatum	1	1	–	1	1	1	–	1	1	1
miles forma indica	1	–	–	–	1	1	–	1	1	1
rotundata	–	–	–	–	–	1	–	–	1	–
Gonyaulax spp.	1	–	–	–	1	1	1	1	1	1
Gymnodinium spp.	–	–	–	–	–	1	–	–	1	–
Ornithocercus magnificus	1	1	1	–	1	1	–	1	1	1
Prorocentrum compressum	–	–	–	–	1	–	–	–	–	–
micans	–	–	–	1	1	–	–	–	1	–
rostratum	–	–	–	–	–	1	1	1	1	–
Protoperidinium claudicans	1	–	–	–	1	1	–	1	1	–
diabolus	–	–	–	–	–	1	1	1	–	–
divergens	–	–	–	–	–	1	1	–	–	–
globulus	1	1	1	–	1	–	–	–	–	–
leonis	1	–	–	–	–	–	–	–	–	–
oceanicum	–	–	–	1	–	1	–	–	–	–
sphaericum	1	1	–	1	1	–	–	–	–	–
spp.	1	–	1	–	–	1	1	1	1	1
Pyrophacus horologicum	–	–	–	–	–	–	1	1	–	–
SILICOFLAGELLATES										
Dictyocha fibula	1	–	–	–	–	–	–	–	–	–
CYANOPHYTA										
Oscillatoria spp.	1	1	1	1	1	1	3	3	3	3

Table 2. Determination of chlorophyll a in water samples from Brunei Bay.

Date	Station	Depth (m)	Chlorophyll A (microgram)
22/11 (1984)	18	0.5	0.76
22/11	18	5	0.53
22/11	18	15	0.66
26/11	21	0.5	0.37
26/11	21	15	0.85
26/11	22	0.5	0.95
26/11	22	15	0.60
30/11	39	0.5	0.89
30/11	39	15	0.16
7/12	18	0.5	0.97
7/12	18	15	0.68
19/4 (1985)	18	0.5	0.21
19/4	18	17.5	0.26
19/4	24	0.5	0.33
19/4	24	10	0.39
19/4	24	20	0.21
20/4	39	0.5	0.25
20/4	39	5	0.26
20/4	39	16	0.25
21/4	22	0.5	0.16
21/4	22	16	0.31
21/4	18	0.5	0.12
21/4	18	17	0.43

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Table 3. **Primary production in Brunei Bay 1984 and 1985**

Date		Production : mg C $m^{-2}hr^{-1}$	Station
1984	Nov 22	42,36	18
	Dec 7	50,69	18
	Nov 26	53,31	21
	Nov 26	50,25	22
	Nov 30	36,47	39
	mean :	47,02	
1985	April 19	15,58	18
	April 21	13,21	18
	April 21	19,39	22
	April 18	12,40	22
	April 19	17,60	24
	mean :	15,64	

Table 4. Zooplankton caught in Brunei Bay in November–December 1984

x = single specimen; xx = occasional; xxx = abundant; xxxx = very abundant

	Station : 8	9	10	17	18	21	22
PROTOZOA							
Tintinnids	x						x
METAZOA							
Hydrozoa							
Hydroidea			x	x	x	x	
Siphonophora	x	x	x	x			
Chaetognatha	xx	xx	xx	xx	xx	xx	xx
Mollusca							
Bivalvia			xx	xx	x	x	x
Gastropoda	x	x	x	x	x	x	x
Echinodermata	x			xx	x		xx
Tunicata							
Appendiculariae	xx	xx	xx	xx	xx		xx
Doliolida				x	xx		xx
Polychaeta	x	x	x	xx	xx	x	xx
Nemertini							
Pilidium larvae					x		x
Bryozoa							
Cyphonautes larvae							
Brachiopoda			x				x
Crustacea							
Cirripedia	xx		x	xx		x	xx
Ostracoda	x	xx	xx	xx	x	xxx	xx
Cladocera	x	xx	xx	xx	xx	xx	xx
Copedoda							
Calanoids	xxx	xx	xxx	xxx	xxx	xxx	xxx
Cyclopoids	xxx	xx	xxx	xxx	xxx	xx	xxx
Harpacticoids	xx	x	xx	xxx	xx	xx	xx
Decapoda							
Prawn larvae	x	xx	xx	xx	x	xx	xx
Crab larvae	x		xx	x	x	x	x

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Table 5. Zooplankton caught in Brunei Bay in April 1985.

x = single specimen; xx = occasional; xxx = abundant; xxxx = very abundant

	Station :			
	18	22	22	39
PROTOZOA		18/4	21/4	
Tintinnids		x		
METAZOA				
Hydrozoa				
Hydroidea				
Siphonophora	x	xx		
Chaetognatha	xxx	xxx	xxx	xx
Mollusca				
Bivalvia	x	x	xx	
Gastropoda		x	x	
Echinodermata		x	xx	
Tunicata				
Appendicullariae	xxx	xxx	xxx	xx
Doliolida	x		xx	
Polychaeta	x	xx	xx	x
Nemertini				
Pillidium larvae		x		
Bryozoa				
Cyphonautes larvae		x		
Brachiopoda				
Crustacea				
Cirripedia		x		xx
Ostracoda	xx	x	xx	xx
Cladocera	x			
Copepoda				
Calanoids	xxx	xxx	xxx	xx
Cyclopoids	xxx	xxx	xxx	xx
Harpacticoids	xxx	xx	xx	xx
Decapoda				
Prawn larvae		x	x	x
Crab larvae				

Table 6. Ust of fish species caught using survey net in the coastal area of Sipitang, November-December 1984.

Ariidae
- ***Arius doriae***
- ***A. sagor***

Balistidae
- ***BaJistes stellatus***

Bothidae
- ***Pseudorhombus javanicus .***
- ***P. malayanus***
- ***P. oilgodon***

Carangidae
- ***Alectis ciliaris***
- ***Caranx ignobilis***
- ***Caranx***
- ***Carangoides praeuctus***
- ***C uii***
- ***Carangoides***
- ***Scomberomorus tol***
- ***Selaroides leptolepis***

Centropomidae
- ***Ambassis kopsii A.***
- ***urotaenia***

Clupeidae
- ***Anotontostoma chacunda***
- ***Sardinella fimbriata S.***
- ***melanura Sardinella***

Cynoglossidae
- ***Cynoglossus***

Dasyatidae
- ***Himantura.*** **1**
- ***Himantura*** ***2***

Ephippidae
- ***Drepane punctata***

Eugraulidae
- ***Eugraulis kammalensis***
- ***E. mystax***
- ***Stolephorus heterolobus***

Table 6. (continued)

Gerreidae
- ***Genes abbreviatus***
- ***G. filamentosus***
- ***G. kapas***
- ***G. punctatus***

Leiognathidae
- ***Gazza minuta***
- ***Leiognathus bindus***
- ***L. elongates***
- ***L. leuciscus***
- ***L. lineolatus L ruconius***
- ***L. splendent***
- ***L.* sp. *(*cf. *daura)***

Lutjanidae
- ***Chelon dussumieri***

Mullidae
- **Upeneus moluccensis U. sulphureus**

Nemipteridae
- ***Nemipterus faponicus***
- ***N. peronil***

Rajidae
- ***Raja* sp.**

Sciacnidae
- ***Pseudoscianidae doldado***

Scorpaenidae
- ***Parascorpaena picta***

Serranidae
- ***Epinephelus merra***
- ***E. sexfasiatus***

Soleidae
- ***Pardachims pavoninus***

Teraponidae
- ***Terapon puta***

Trichiuridae
- ***Trichiurus lepturus***

Table 7. Fish species, number of individuals (A) and total weight in grams (B) for each species, caught by survey nets at 2 m depth 400 m NW of Tg Merintaman. Fishing was carried out during 13 hrs in the night, November 1984.

	(A)	(B)
Ariidae		
Arius doriae		
A sagor	25	2252
Bothidae		
Pseudorhombeus oilgodon	1	150
Carangidae		
Carangoides praeustus	3	160
C uii	2	100
Scomberomorus tol	4	91
Centropomidae		
Ambassis (Chanda) kopsii	2	12
A. urotaenia	3	30
Clupeidae		
Anatontostoma (Dorosoma) chacunda	24	312
Sardinella fimbriata	185	2220
Sardinella	3	168
Cynoglossidae		
Cynoglossus **sp.**	2	68
Centropomidae		
Himanturasp. **1**	3	330
Himantura	1	102
Eugraulidae		
Eugraulis (Thryssa) kammalensis		
E. mystax	10	150
Stolephorus heterolobus	5	50
Ephippidae		
Drepane punctata	5	150
Gerridae		
Gerres abbreciatus	10	445
Leiognathidae		
Gazzaminuta	49	500
Leiognathus elongatus	13	65

Table 7. (continued)

Mugilidae		
Chelon dussumieri	3	78
Sciaenida		
Pseudosciaena soldado	17	875
Scorpaenidae		
Parascorpaena picta	1	48
Serranidae		
Epinephelus merra	2	145
Soleidae		
Pardachirus pavoninus	1	24
Trichiuridae		
Trichiurus lepturus	3	600

Table 8. **Fish species, number of individuals (A) and total weight in grams (B) for each species, caught by survey nets during 4 hrs at 17.5 m depth 400 m E of jetties. November 1984. Fishing was carried out during day time.**

Family and species	(A)	(B)
Carangidae		
Carangoides uii	1	56
Clupeidae		
Sardinella fimbriata	4	50
S. melanura	1	8
Dasyatidae		
Himantura sp. 3	1	170
Drepanidae		
Drepane punctata	1	160
Eugraulidae		
Stolephorus heterolobus	3	8
Gerridae		
Gerres filamentosus	1	24
Leiognathidae		
Leiognathus bindus	3	8

L. elngoatus	5	52
L. leuciscus	1	15
L. lineolatus	2	11
L. ruconius	20	126
L. splendens	4	10
Mullidae		
Upeneus sulphureus	2	32
Nemipteridae		
Neimpterus japonicus	3	292
Serranidae		
Epinephelus sexfasciatus	1	24

Table 9. **Fish species, number of individuals (A) and total weight in grams (B) for each species, caught by survey nets at 15 m depth at Takat Dua Darat, 2 km SE of Tg. Merintaman. Fishing was carried out during 3.5 hrs at day time in November 1984.**

	(A)	(B)
Balistidae		
Aleutera monoceros	1	400
Carangidae		
Alectis ciliaris	1	300
Ephippidae		
Drepane punctata	2	750
Lutjanidae		
Lutjanus sanguineus	1	130
Nemipteridae		
Nemipterus japonicus	1	49
N. peronii	1	5
Rajidae		
Raja sp.	2	700
Teraponidae		
Terapon puta	700	1050

Table 10. **Fish species, number of individuals (A) and total weight (B) for each species caught by survey nets during 2.5 hrs at 10 m depth 500 m SE of Tg Merinta man. November 1984. Fishing was carried otu during day time.**

Family and species	(A)	(B)
Balistidae		
Balistes stellatus	2	190
Bothidae		
Pseudorhombus javanicus	1	75
P. malayanus	1	190
Carangidae		
Caranx ignobilis	1	190
Caranx	1	104
Carangoides	1	100
Selaroides leptolepis	3	61
Clupeidae		
Sardinella fimbriata	1	13
Sardinella	1	10
Ephippidae		
Drepane punctata	2	544
Gerridae		
Gerres abbreviatus	1	43
G. filamentosus	2	118
G. kapas	4	95
G. punctatus	2	52
Leiognathidae		
Leiognathus splendens	3	11
L. sp. *leuciscus)*	1	22
L sp. (cf. *daura)*	1	6
Lutjanidae		
Lutjanus sp.	1	56
Mullidae		
Upeneus moluccensis	1	20

Table 11. **List of fish species caught using beach sein net in the coastal area of Sipitang. November-December 1984.**

Apogonidae
Apogon cf. *fasciatus*
Gen. et. sp. indet.

Ariidae
Arius sp.

Atherinidae
Atherina sp. 1
Atherina
Atherina

Belonidae
Tylosurus crocodilus
T. strongylurus

Bothidae
Pseudorhombus javanicus

Callionymidae
Repomucenus sagitta

Carangidae
Carangoides praeustus
Gen. et. sp. indet.

Centropomidae
Ambassis kopsii
A. urotaenia

Cynoglossidae
Arelia bilineata
Cynoglossus bilineatus
Cynoglossus
Paraplagusia bilineata
P. blochii

Eugraulidae
Stolephorus heterolobus
S. indicus
S. tri

Gerreidae
Gerres macracanthus
Gerres

Table 11. continued

Gobiidae
Acentrogobius bontil
Acentrogobius
Favonigobius reichei

Hemirhamphidae
Hyporhampus gaimardi
Zenarchopterus

Leiognathidae
Leiognathus equulus L.
fasciatus Leiognathus
Gazza minuta

Mugilidae
Chelon vaigiensis
***Mugil* sp.**

Nemipteridae
Nemipterus peronil

Platycephalidae
Platycephalus bataviensis

Sillaginidae
Sillago japonica
S. maculata

Teraponidae
Terapon jarbua

Tetraodontidae
Sphoeroides honckenii
Tetraodon patoca

Table 12. **Fish species, number of individuals (A) and the total weight in grams (B), caught using a sein net in the shallow water outside the mangroves 300 m W of the mouth of Si Marantongan. Four shootings of the net was conducted at day time, November 1984.**

	(A)	**(B)**
Ariidae		
Arius sp. (juv)	1	4

Atherinidae		
Atherina sp. 3	1	5
Centropomidae		
Ambassis kopsii	5	25
Gobiidae		
Favonigobius reichei	3	6
Hemirhamphidae		
Zenarchopterus sp.	4	21
Mugilidae		
Chelon vaigiensis	20	38
Nemipteridae		
Nemipterus peronii	1	3
Tetraodontidae		
Tetraodon patoca	1	8
Leiognathidae		
Leiognathus fasciatus	5	28

Table 13. **Fish species, number of individuals (A) and the total weight in grams (B), caught using a sein net on the beach 1.4 km NW of the jetties. Five shootings of the net was conducted at day time, November 1984.**

	(A)	(B)
Centropomidae		
Ambassis urotaenia (juv)	50	45
Cynoglossidae		
Paraplagusia bilineata	1	5
Atherinidae		
Atherina sp 1	40	60
Eugraulidae		
Stolephorus indicus	12	15
Gerreidae		
Gerres sp. (juv)	55	25
Hemirhamphidae		
Hyporhampus gaimardi	9	10
Leiognathidae		
Leiognathus sp.	1	5

Mugilidae		
Chelon vaigiensis (juv)	60	75

Table 14. **Fish species, number of individuals (A) and the total weight in grams (B), caught using a sein net on the beach 1 km S of Tg Merintaman. Seven shotings of the net was conducted at day time, November 1984.**

	(A)	(B)
Belonidae		
Tylosurus strongylurus	14	146
Bothidae		
Pseudorhombus javanicus	2	232
Centropomidae		
Ambassis urotaenia	1	10
Cynoglossidae		
Arelia bilineata	3	7
Cynoglossus bilineatus	3	340
Cynoglossus	4	18
Paraplagusia bilineata	9	51
P. blochii	3	49
Eugraulidae		
Stolephorus tri	24	106
Gerreidae		
Gerres sp. (juv)	25	35
Leiognathidae		
Leiognathus equulus	1	10
Gazza minuta	1	5
Mugilidae		
Chelon vaigiensis	15	38
Sillaginidae		
Sillago japonica	35	210
Teraponidae		
Terapon jarbua	1	26
Tetraodontidae		
Sphoeroides honckenii	4	22

Table 15. **Fish species, number of individuals (A) and the total weight in grams (B), caught using a sein net in the shallow water outside the mangroves in Telok Batu Bedara in the mouth of Si Merintaman. Seven shootings of the net was conducted at day time, November 1984.**

	(A)	(B)
Apogonidae		
Apogon cf. *fasciatus*	1	5
Gen. et. sp. indet.	1	4
Atherinidae		
Atherina sp. 1	1	2
Atherina	1	4
Belonidae		
Tylosurus crocodilus	1	20
T. strongylurus	1	20
Carangidae		
Carangoides praeustus	2	6
Gen. et. sp. indet. (juv)	4	4
Centropomidae		
Ambassis kopsii	1	2
Cynolossidae		
Arella bilineata	1	4
Eugraulidae		
Stolephorus heterolobus	5	7
Gerreidae		
Gerres macracanthus	2	4
Gobiidae		
Acentrogobius bontii	3	5
Acentrogobius	1	1
Favonigobius reichei	4	4
Leiognathidae		
Leiognathus sp. (juv)	1	1
Mugilidae		
Chelon vaigiensis	1	2
Mugil sp. (juv)	33	35

Platycephalidae ***Platycephalus bataviensis***	**1**	**10**
Sillaginidae ***Sillago maculata***	**3**	**26**
Teraponidae **Terapon jarbua**	**1**	**11**