

SEASONAL VARIATIONS OF CERTAIN MAJOR ZOOPLANKTON
GROUPS AROUND PANGGANG ISLAND,
NORTH-WEST OFF JAKARTA

By

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ABSTRACT

Seasonal and annual variations of the composition of zooplankton in the water around Panggang Island were studied from May 1971 to April 1973. Temperature and salinity of the water and the abundance of zooplankton were assumed to be affected by the monsoon. It was usually found that the abundance of zooplankton in this area coincided with or occurred after the heavy rainfall. The occurrence of many zooplankton groups in each season did not greatly change, but the intensity of total number were vary in certain groups. The pattern of the annual variation of the zooplankton number was nearly regular in the two years of investigations. The major groups of zooplankton observed during this investigations were also discussed.

In general the zooplankton of the water of Panggang Island were typically neritic. Some bigger species of copepods were even less than in the Java Sea.

IKHTISAR

Variasi musiman dan tahunan komposisi zooplankton di perairan Pulau Panggang diamati dari bulan Mei 1971 sampai dengan April 1973. Suhu dan salinitas serta banyaknya zooplankton diduga sangat dipengaruhi oleh musim. Pada umumnya banyaknya zooplankton di perairan ini dijumpai bertepatan dengan atau sesudah turun hujan lebat. Terdapatnya beberapa golongan zooplankton setiap musimnya tidak mengalami perubahan besar, namun intensitas jumlahnya berbeda pada golongan zooplankton tertentu. Pola variasi tahunan jumlah individu zooplankton hampir teratur selama dua tahun pengamatan. Golongan besar zooplankton yang terlihat selama pengamatan telah pula dipaparkan.

Pada umumnya zooplankton di perairan Pulau Panggang bersifat neritik. Beberapa jenis Copepoda besar bahkan lebih sedikit bila dibandingkan dengan yang terdapat di Laut Jawa.

INTRODUCTION

The data of plankton and hydrology are the invaluable information for fisheries and these data have been used for catching fish in the developed countries. In the past, however, plankton communities of Seribu Islands water were neglected. In order to catch fish, the fishermen in Jakarta and Seribu Islands usually fished to a place where generally had many fish and when the sea was calm. They did not have any know-

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ledge of plankton migration and plankton seasonal variations. Therefore, it is necessary to make a comprehensive study on plankton in Seribu Islands water in order to discover another fishing ground.

The plankton of the Java Sea, which might have some influences on the water of Seribu Islands, has not been studied properly. Some papers, based mainly on short-termed cruises, have been written by various workers such as CLEVE (1901), ALLEN and CUPP (1935), DELSMAN (1939 & 1949), PRASENO and TJEE (1966), PRASENO and ARINARDI (1974), and NONTJI and ARINARDI (1975). Primary productivity has been studied by DOTY *et al* (1963), and SOEGIARTO and NONTJI (1966). The investigations of the hydrological conditions of the Java Sea have been studied, among others, by BERLAGE (1927), SOERIA-ATMADJA (1956), SJARIF (1959), WYRTKI (1956 & 1961), and RAHARDJO and ILAHUDE (1965).

This study is aimed at getting comprehensive picture of the seasonal and annual variations of the zooplankton composition of the water around Panggang Island, one of the islands of Seribu Islands group, north-west off Jakarta. It is a hope that this paper will make a basis for a more comprehensive survey, qualitatively as well as quantitatively.

MATERIALS AND METHODS

General Hydrological Conditions

Seribu Islands are a group of islands which are distributed from north to south at the north-west off Jakarta. The water which surrounds the islands is known as the water of Seribu Islands. The depth of the water ranges from 10 to 90 m with the average of 30 m. The water of Seribu Islands is connected with the Java Sea and the mean monthly surface temperature and salinity in this vicinity still followed the characteristics of the Java Sea (KARTORO and BIROWO 1974). The current systems of the Java Sea are influenced by the monsoon. During the west monsoon, which usually prevails from December to February, the mass of water with low salinity (less than 32.0‰) flows eastwardly from the South China Sea. As the result of the run-off of the rivers from Sumatera, Java and Kalimantan, this salinity becomes lower. During the full east monsoon, which prevails from June to August, the mass of water with high salinity (about 34.0‰) flows westwardly. This mass of water comes from Indian Ocean through Flores Strait, and from Pacific Ocean through Sulu Sea and Makassar Strait. Between these two monsoons there are two periods which are usually known as the transition periods, during which the sea temperature is generally high and the sea is calm compared to the situation in the rest of the year (BERLAGE 1927, VEEN 1953, WYRTKI 1956 & 1961).

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The Location Of The Stations

The zooplankton hauls were made at nine stations which were located around Panggang Island (Fig. 1). Regular monthly collections between 7 a.m. and 3 p.m. local time at the end of each month were maintained from May 1971 to April 1973. However, in April 1972 and February 1973 the sampling of plankton could not be made due to some difficulties.

Sampling used a Norpac net with mouth diameter of 45 cm and mesh size of 0.33 mm. At the centre of the mouth net, a TSK flowmeter was mounted. Sampling was done vertically from the depth of 20 m up to the surface. The samples were preserved in 4% natural formaline. The displacement volume was done according to the method of WICKSTEAD (1965). The preserved sample was then made up to a known volume (generally 100 ml) and two fractions (usually 2 x 2.5 ml) were quickly removed by a stemple pipette into a counting tray and examined under a binocular microscope. The organisms were all counted.

Water temperature and salinity were also studied. The temperature was measured by a reversing thermometer and the salinity of the water was determined according to the method of KNUDSEN.

R E S U L T S M E T E O R O L O G Y A N D H Y D R O L O G Y

Rainfall

In 1971 — 1972 the dry season lasted from July 1971 till September 1971. During this period the rainfall was very low (Fig. 2). The rainy season started in October 1971 and the maximum rainfall was reached in January 1972. During 1972 — 1973 the dry season lasted longer than the previous year, from June to November 1972. This longer dry season seemed having an effect to the hydrological conditions viz. temperature and salinity of the water (Fig. 2).

Temperature

In 1971 — 1972 the minimum temperature (27.50°C) was observed in January 1972 and the maximum (29.80°C) in October 1971 (Appendix I). The mean value was 28.63°C. During 1972 — 1973 the temperature was recorded between 28.23°C and 30.08°C (Appendix II). The mean temperature in this period was 29.06°C.

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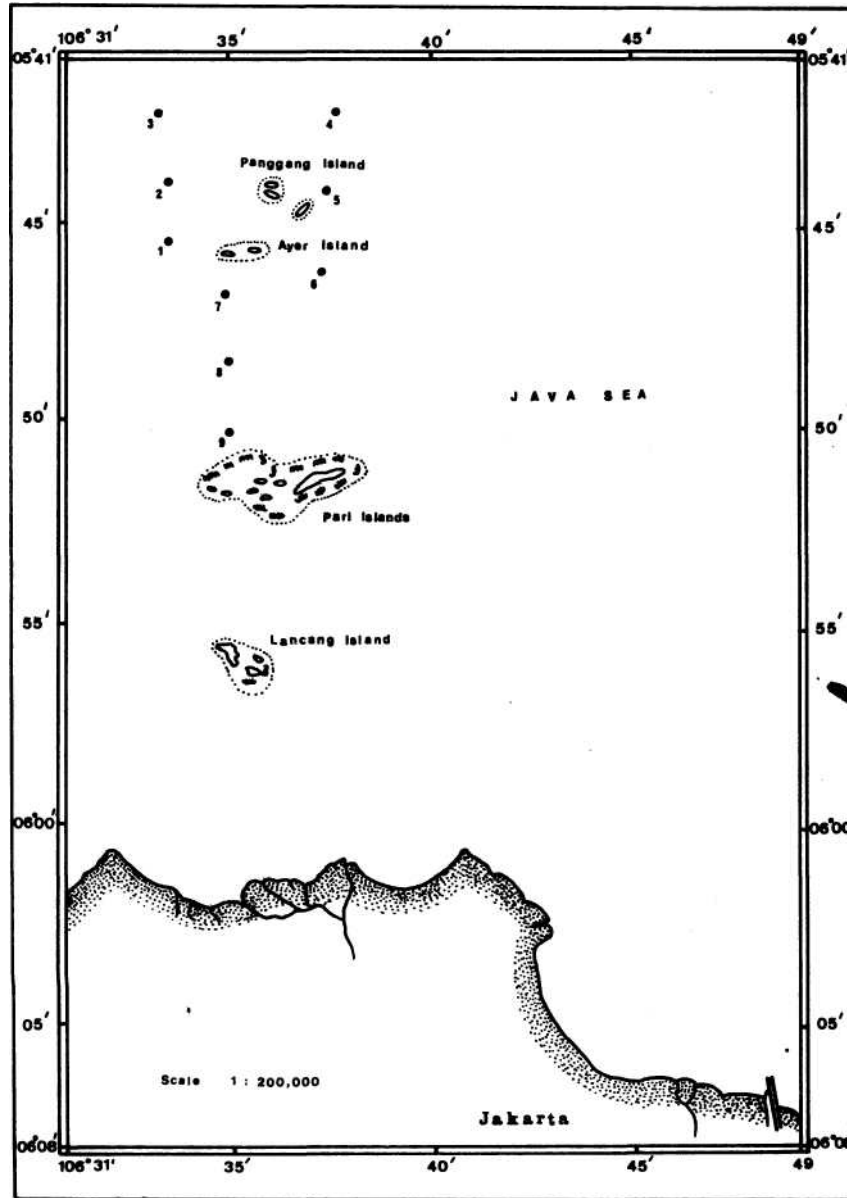


Figure 1. The station positions in the water around Panggang Island where collections and observations were made in 1971 — 1972 and in 1972 — 1973.

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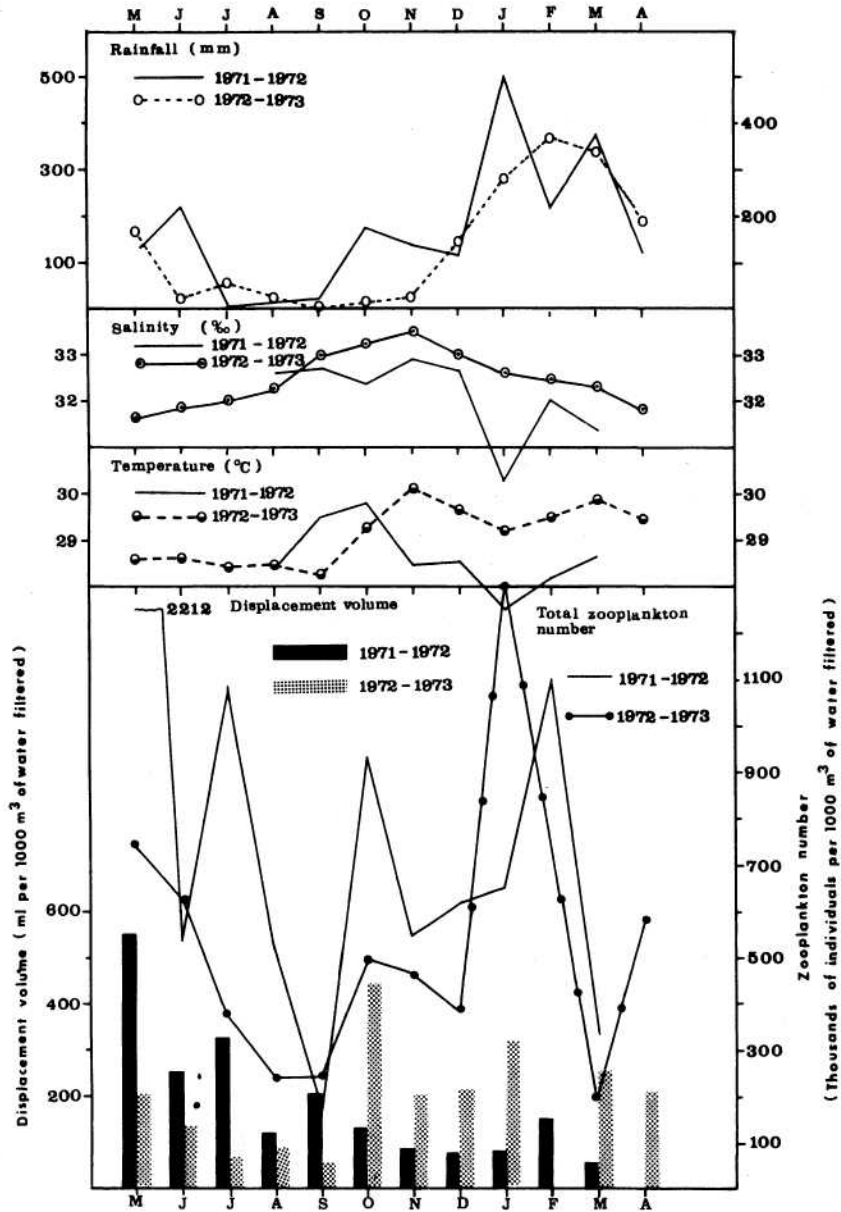


Figure 2. Variations of rainfall, surface salinity, surface temperature, displacement volume and zooplankton number in the water around Panggang Island during the observation periods.

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Salinity

In 1971 — 1972 the minimum salinity (30.29‰) was also recorded in January 1972, coincided with the heavy rainfall. The maximum salinity (32.90‰) was found in November 1971 (Appendix I). The mean salinity during this period was 32.11‰. In 1972 — 1973 the salinity varied between 31.61‰ and 33.50‰ (Appendix II) with the mean value 32.48‰.

ZOOPLANKTON

(Fig. 3 and Fig. 4)

Protozoa

Only the common Protozoa were counted. The most common protozoan, almost present throughout the year, was radiolarian (*Ancathometra* sp. ?). It reached maximum number in May 1972. Other protozoan was *Noctiluca* sp., abundant in January 1972.

Coelenterata

Hydroida

Anthomedusae, Leptomedusae, and Trachymedusae were present throughout the year. At times the number quite plentiful, for instance in November, December 1971 and October 1972.

Siphonophora

During 1971 the siphonophores occurred in abundance in October and in November 1971. In 1972 they were found in abundance from May to October 1972. The most common genera encountered were *Diphyes* and *Lensia*.

Chaetognatha

Chaetognaths were found in great number throughout the periods of investigations, except in September 1971. The most common genus was *Sagitta*.

Annelida

Tomopteris sp. occurred occasionally and only in rare number. Other polychaet larvae were present almost throughout the year but rarely in large number.

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Crustacea

Cladocera

This group was very rare. The only genera recorded were *Evadne* and *Penilia*. The former was found more numerous than the latter.

Ostracoda

This group was rather common. During 1971 — 1972 they were found abundantly in period between June and August 1971. In 1972 — 1973 the abundance was recorded in July, August, September 1972 and January 1973. For the rest of the months they appeared in small number or absent. The common genera were *Euconchoecia* and *Pyrocypriis*.

Copepoda

The copepods formed the major component of the zooplankton community (varied between 15.92% and 66.38%) almost throughout the year, except in September 1971, March, August 1972 and March 1973. The calanoids were more predominant than the other groups of copepods.

It seemed that the abundance of calanoids appeared after or coincided with the rainfall. The most common genera were *Acrocalanus*, *Paracalanus*, *Eucalanus*, *Centropages*, *Temora* and *Acartia*.

The cyclopoids usually had less number than the calanoids did, but in March 1973 the record showed more cyclopoids than calanoids. The common genera of the cyclopoids were *Oithona* and *Corycaeus*, some species of *Oncaea* were recorded and *Sapphirina* and *Copilia* were rarely caught.

The harpacticoids were never found in abundance throughout both years of observations, except in July and October 1971. The common genera that could be encountered were *Euterpina* and *Macrosetella*. *Microsetella* and *Clytemnestra* were rarely observed.

Cirripedia larvae

This group was never found in great number.

Mysidacea and Euphausiacea

These two groups of zooplankton were very rare.

Amphipoda

Amphipods were never observed in abundance. The common genus was *Hyperia*.

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Decapoda larvae

Included to this group were the larvae of *Macrura*, *Brachyra* and *Anomura*. They were found in fair number particularly during 1972 — 1973. *Lucifer* sp. was almost found throughout both years of investigations but rarely in great number. The higher number of decapod larvae were observed in July 1971, May, June 1972 and January 1973.

Mollusca

Molluscs were found throughout the years of investigations. There were three periods in which the molluscs were in high count, that was in August, November 1971 and September 1972. The common genus of molluscs was *Creseis*.

Echinodermata

In 1971 — 1972 the larvae of echinoderm were very abundant in May 1971 and March 1972. During 1972 — 1973 there were three peaks; in May, November 1972 and April 1973. The most common echinoderm larvae were ophiuroid larvae and echinoid larvae.

Tunicata

Larvacea

This group could be found throughout both years of investigations though rarely in high quantity. In 1971 — 1972 the higher number were observed in July 1971 and February 1972. During 1972 — 1973 the peaks were found in October 1972 and January 1973. The most common genus of tunicates was *Oikopleura*, *Fritillaria* rarely observed.

Thaliacea

Thaliaceans were usually more abundant in dry season. During 1971 — 1972 the prominent number were recorded in May, July and September 1971. In 1972 — 1973 the abundance of thaliaceans was found in October, November and December 1972. The common genera of this group were *Thalia* and *Doliolum*. The latter were less than the former.

Vertebrata

Fish eggs and fish larvae were not very abundant in the area of investigations throughout both years of observations, but they were rarely absent.

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DISPLACEMENT VOLUME AND TOTAL NUMBER (Appendix III and Appendix IV)

During 1971 — 1972 the displacement volume of zooplankton was found extremely high in May 1971 (554 ml/1,000 m³) due to the outburst of the echinoderm larvae. The second and third peaks happened in July and September 1971, then the volume decreased gradually and reached the minimum in December 1971 (80 ml/1,000 m³), till it reincreased in February 1972 (155 ml/1,000 m³). This was after the maximum rainfall in January 1972. The lowest value was found in March 1972 (62 ml/1,000 m³). The mean displacement volume was 189 ml/1,000 m³. The peaks of the total zooplankton number were observed in May, July, October 1971 and February 1972 (2,212; 1,081; 933; 1,099 individuals/1,000 m³ respectively). The mean total number was 793,638 individuals/1,000 m³.

In 1972 — 1973 rather high displacement volume was found in May 1972 (211 ml/1,000 m³), which coincided with the peak of the rainfall. The second peak was observed in October 1972 (449 ml/1,000 m³). The third peak of volume was recorded in January 1973 (326 ml/1,000 m³). This was also coincident with the rising of the rainfall. The mean displacement volume was 205 ml/1,000 m³. The zooplankton showed the same pattern with the fluctuations of the displacement volume. The first peak was found in May 1972 (740 individuals/1,000 m³), and gradually decreased till it reached the minimum in August 1972 (238 individuals/1,000 m³). The second peak was observed in October 1972 (494 individuals/1,000 m³) and the third peak was recorded in January 1973 (1,301 individuals/1,000 m³). The mean total number was 511,328 individuals/1,000 m³.

SEASONAL AND ANNUAL VARIATIONS

Studies on the seasonal variations of the zooplankton composition of the various planktonic groups showed that there was a slight change in the zooplankton community (Figs. 3 —5). During 1971 - 1972, after the rainy season in May 1971, there was a blooming of echinoderm larvae. In this period, the other important groups of animals that were encountered were chaetognaths, calanoids, cyclopoids, larvaceans and thaliaceans. This composition still remained till June 1971. In July 1971 (the beginning of the dry season) there were extremely high number of ostracods and salpids. At the end of the dry season (September 1971), the number of the zooplankton, however, were exceptionally low. When the rainy season was beginning in October 1971, there was an outburst of calanoids. Other prominent groups of zooplankton were coelenterates, chaetognaths, crustaceans non copepods, cyclopoids and larvaceans. From November

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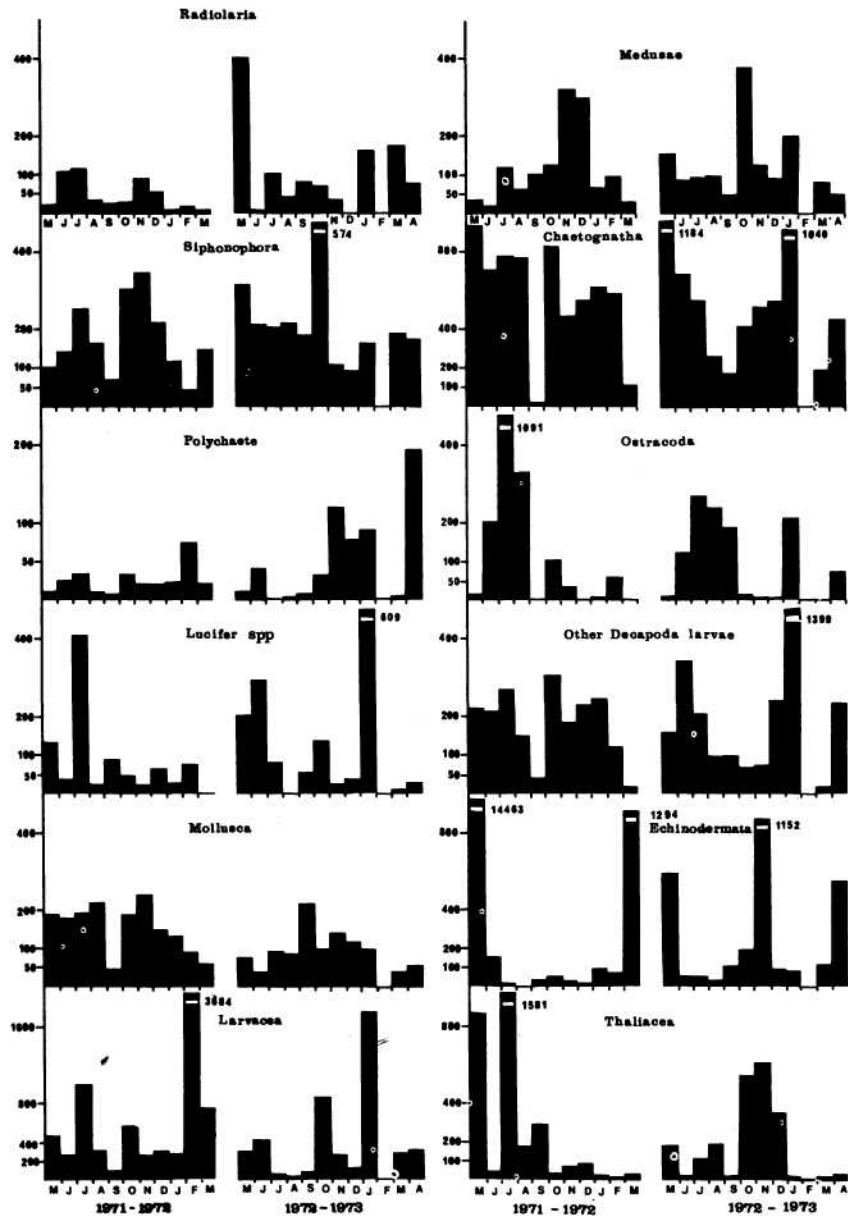


Figure 3. The abundance of zooplankton, expressed as thousands of individuals per 1,000 m³ of water filtered, throughout the observation periods.

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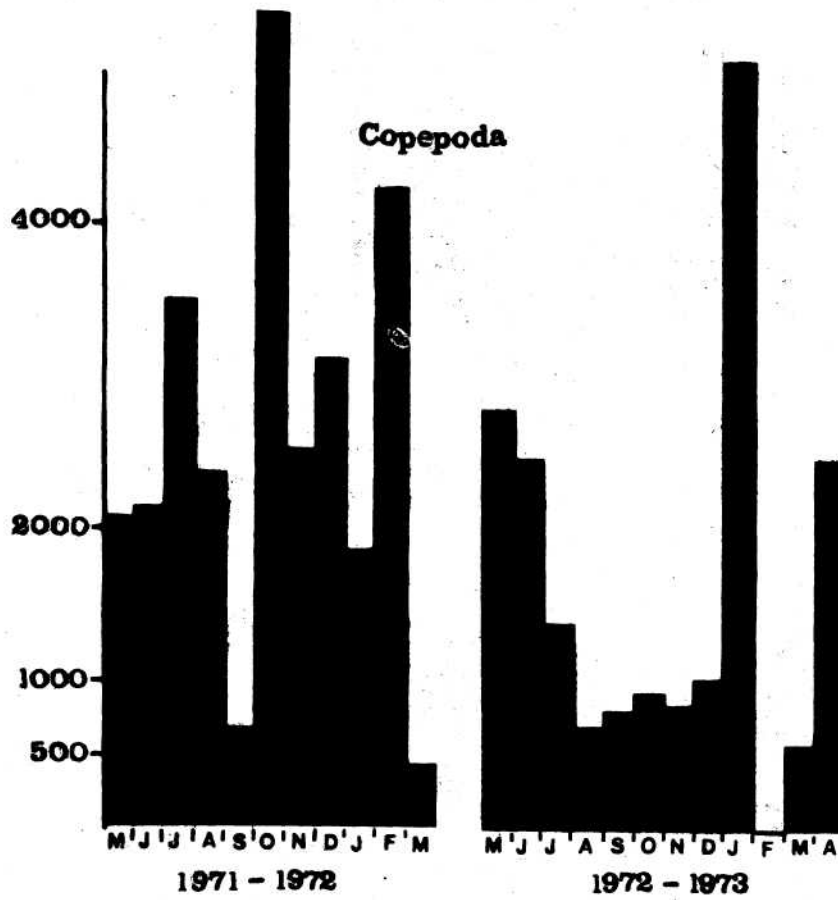


Figure 4. The abundance of Copepoda, expressed as thousands of individuals per 1,000 m³ of water filtered, throughout the observation periods.

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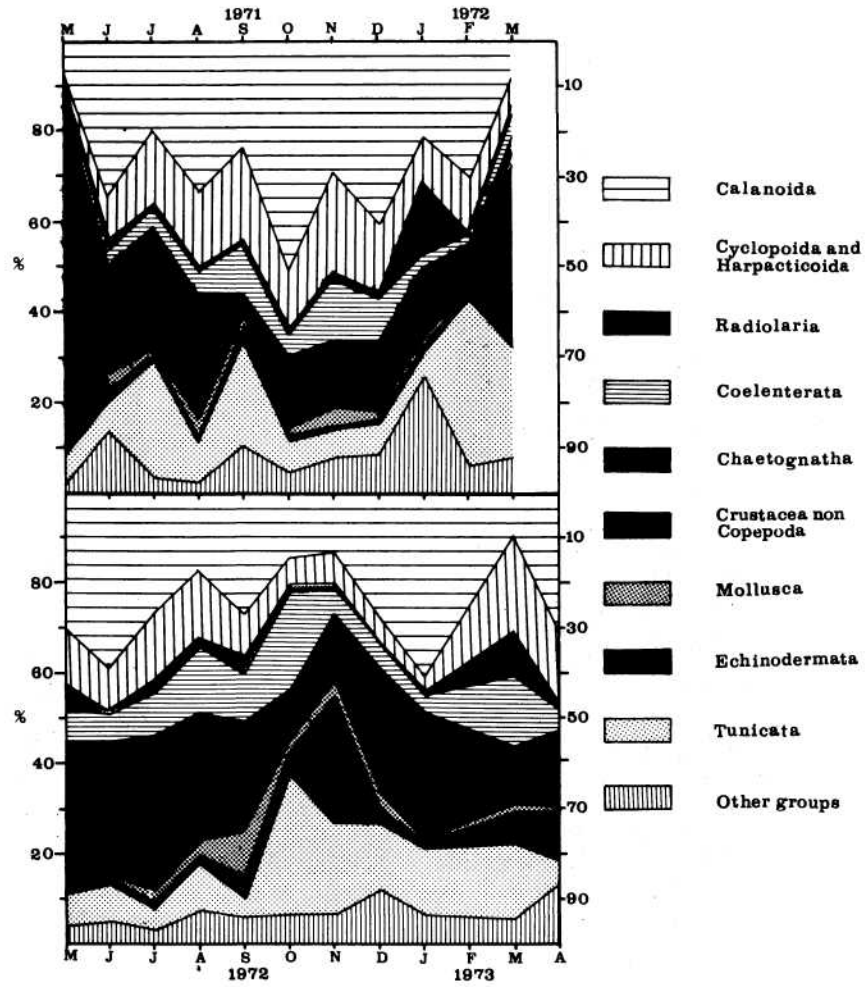


Figure 5. Variations in the relative abundance of major zooplankton groups from May 1971 to March 1972 and from May 1972 to April 1973.

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1971 to January 1972 the composition still unchanged. In February 1972, after the heavy rainfall in January 1972, there was a blooming of *Oikopleura* sp. In March 1972 the blooming of the echinoderm larvae reappeared.

In 1972 - 1973, at the end of the wet monsoon (May 1972) the zooplankton relatively in high number were coelenterates, calanoids, cyclopoids and echinoderm larvae. In this month chaetognaths were found extremely high when it was compared to the rest of the year. In June 1 972 (the beginning of the dry season) chaetognaths, ostracods, calanoids, *Lucifer* sp. and larvaceans were moderately high. In August-September 1972 the zooplankton were observed in very low number. At the end of this season, however, siphonophores, medusae, larvaceans and thaliaceans were found extremely high. A blooming of echinoderm larvae was also recorded. After the heavy rainfall in January 1973, all organisms were nearly observed in large number, especially chaetognaths, calanoids, decapod larvae and *Oikopleura* sp. were encountered in blooming. At near the end of the wet season the echinoderm larvae were found in abundance again.

The pattern of the annual variations in the zooplankton was more or less regular in the two years of investigations (Figs. 2 — 4). The seasons of occurrence of many zooplankton groups did not greatly change, but the intensity of total number varied in certain groups. Ostracods, copepods and tunicates showed higher number of occurrence in the first year, while coelenterates, polychaetes, *Lucifer* sp. and other decapod larvae were more plentiful in the second year.

During the first year, echinoderm larvae were showing outburst in May 1971 and in March 1972. In the second year the greatest number of echinoderm larvae was recorded in November 1972. The chaetognaths, for both years of investigations, showed quite the same number.

DISCUSSIONS AND CONCLUSIONS

During the wet season the temperature and salinity values in this vicinity were usually low, especially after the heavy rainfall in January 1972, which dropped to minimum (Fig. 2). In this month the total zooplankton number were relatively low. In February 1972, in accordance with the increasing of the temperature and salinity, the zooplankton were observed in a large number. The changes in the temperature and salinity of the water seemed to play a role to the abundance of zooplankton population, however, as suggested by WICKSTEAD (1958) these parameters were not the real causative factors. Temperature, salinity and the abundance of zooplankton assumed to be affected by a common factor, that was the monsoon. This assumption may be accepted by comparing with the variations of the hydrological para-

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meters and the total amount of zooplankton. The abundance of zooplankton in this area generally coincided with or occurred after the heavy rainfall in the wet monsoon. This was particularly true for the year 1971. The rainy season in 1971 lasted till June 1971. The heavy and continuous rains accompanied by the stormy weather in the sea probably resulting in water mixing of the upper and lower layers. It was worthy to note that a large amount of freshwater which was brought in by the rivers in Java, mainly the Cisdane and the Citarum rivers, influenced the hydrological conditions and hence the nutrient supply of the water around Seribu Islands. This enrichment of the water which was caused by the heavy rainfall and the run-off of the rivers was responsible for the abundance of zooplankton in that vicinity. The effect of the rainfall and the land drainage upon the thriving of the plankton in the Java Sea and the adjacent water has also been mentioned by several authors (DELSMAN 1939, THAM 1953, DOTY *et al.* 1963, CHUA 1970, PRASENO and ARINARDI 1974, NONTJ and ARINARDI 1975 and HUTOMO 1975).

Comparing the intensity of the rainfall in the two years of investigations, it appeared that in the first year which had a higher and longer rainfall, the number of zooplankton was also higher (793,638 individuals/1,000 m³) than the number of zooplankton in the second year (511,382 individuals/1,000 m³). This was perhaps showing other evidence that supported the statement that the changes of the number of zooplankton were closely associated with the intensity of the rainfall.

The total number of the zooplankton communities were changeable in each season. It was noted that the chaetognaths, calanoids and decapod larvae were extremely in low number in September and March within both years. These two months are usually the beginning of the change-over period from dry to wet season and vice-versa. The calanoids, decapod larvae and larvaceans were recorded in high count mostly coincided with or after the heavy rainfall. Ostracods were more common at the beginning of the dry season whilst thadiaceans were more abundant during the dry season.

Throughout both years of investigations, it seemed that the zooplankton observed were nearly all neritic. This observations resembled to the zooplankton of the Java Sea, which was mentioned by DELSMAN (1949) that the zooplankton in the Java Sea were having coastal characters. From this investigations, it showed that some bigger species of copepods such as *Euchaeta* sp. and *Labidocera* sp. were even less in number here than in the Java Sea.

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APPENDIX I.

Rainfall and hydrological data of the water
around Panggang Island, 1971 — 1972.

Month	Rainfall* (mm/month)	Surface temperature (° C)	Surface salinity (‰)
May 1971	117.5		
June	219.2	—	—
July	2.8	-	—
August	13.1	28.40	32.59
September	17.1	29.50	32.70
October	175.9	29.80	32.38
November	135.4	28.50	32.90
December	114.1	28.50	32.62
January 1972	494.1	27.50	30.29
February	219.6	28.20	31.99
March	376.0	28.63	31.39
April	124.6	—	—

Data from Meteorological and Geophysical Institute, Jakarta.

APPENDIX II.

Rainfall and hydrological data of the water
around Panggang Island, 1972 — 1973.

Month	Rainfall* (mm/month)	Surface temperature (° C)	Surface salinity (‰)
May 1972	167.6	28.57	31.61
June	22.0	28.57	31.83
July	56.6	28.43	31.99
August	14.2	28.43	32.50
September	0	28.23	33.02
October	17.4	29.25	33.23
November	26.8	30.08	33.50
December	144.7	29.65	33.00
January 1973	280.0	29.21	32.59
February	369.2	-	—
March	345.3	29.84	32.27
April	190.8	29.44	31.77

* Data from Meteorological and Geophysical Institute, Jakarta.

APPENDIX III.

" Displacement volume (ml/1000 m³) and total number of zooplankton
(thousands indiv./1000 m³) around Panggang Island water, 1971 — 1972.

Month Station	May 1971		J u n e		J u l y		August		September		October	
	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number
1	673	4128	224	367	84	998	91	766	71	120	172	1080
2	475	3674	118	330	75	747	122	779	89	89	75	1045
3	611	2761	151	976	193	1044	102	812	128	162	145	1413
4	604	2104	376	976	103	712	51	558	611	236	145	1072
5	475	564	401	591	103	890	39	422	106	183	72	790
6	658	3200	623	570	196	1031	180	505	199	127	135	904
7	319	1516	294	294	231	632	77	417	225	162	92	541
8	668	1177	46	362	117	878	304	208	178	98	156	843
9	503	788	49	418	1849	2795	158	239	271	289	212	713
Total	4986	19912	2282	4884	2951	9727	1124	4706	1878	1466	1204	8401
Mean	554	2212	254	543	328	1081	125	523	209	163	134	933

APPENDIX III. (Continued)

Displacement volume (ml/1000 m³) and total number of zooplankton
(thousands indiv./1000 m³) around Panggang Island water, 1971 — 1972.

Station \ Month	November		December		January 1972		February		March		April	
	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number
1	169	612	84	271	108	672	235	1458	58	251	No Data	No Data
2	94	724	87	539	78	505	133	1073	58	473		
3	135	886	54	831	76	494	179	1033	63	221		
4	125	225	102	730	56	371	147	1730	31	279		
5	49	433	74	819	45	417	183	968	65	239		
6	27	262	68	913	50	499	124	581	77	399		
7	101	490	111	590	149	585	155	1073	134	820		
8	37	317	71	325	100	874	90	914	35	140		
9	68	1034	68	541	115	1486	147	1063	38	307		
Total	805	4983	719	5559	777	5903	1393	9895	559	3129		
Mean	89	554	80	618	86	656	155	1099	62	348		

APPENDIX

Displacement volume (ml/1000 m) and total number of zooplankton
(thousands indiv./1000 m³) around Panggang Island water, 1972 — 1973.

Month Station	M a y 1972		J u n e		J u l y		A u g u s t		S e p t e m b e r		O c t o b e r	
	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number
1	216	533	103	670	63	125	104	338	97	368	370	471
2	231	727	235	806	134	376	172	450	42	306	868	329
3	231	579	186	558	86	315	73	196	32	329	67	457
4	165	939	144	749	46	267	54	82	65	226	638	517
5	202	800	126	776	175	582	42	153	62	167	336	343
6	226	671	144	490	56	334	173	250	81	187	477	740
7	254	953	35	—	27	398	92	125	34	202	384	883
8	203	928	81	431	58	622	81	363	52	112	677	285
9	174	528	175	526	31	285	58	188	77	253	220	418
Total	1902	6658	1229	5006	676	3304	849	2145	542	2150	4037	4443
Mean	211	740	137	626	75	367	94	238	60	239	449	491

APPENDIX IV. (Continued)

Displacement volume (ml/1000 m³) and total number of zooplankton (thousands indiv. 1000 m³ around Panggang Island water. 1972 - 1973

Month Station	November		December		January 1973		February		March		April	
	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number
1	202	531	248	397	445	1680			161	194	183	623
2	134	370	235	403	222	1407			279	194	202	595
3	108	382	210	400	465	1793	No Data	No Data	1173	223	175	452
4	77	353	248	403	434	1272			97	181	134	608
5	257	616	214	397	323	1032			149	114	186	946
6	134	363	259	—	252	1260	No Data	No Data	101	262	349	599
7	293	440	167	311	367	855			70	175	336	662
8	367	308	186	279	293	1232			98	123	220	326
9	331	815	226	477	132	1176			183	292	147	392
Total	1903	4178	1993	3067	2933	11707			2311	1758	1932	5203
Mean	211	464	221	383	326	1301			257	195	215	578