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ZOOPLANKTON COMMUNITY STRUCTURE AT AWUR BAY IN THE NORTHERN CENTRAL JAVA SEA

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ABSTRACT

Zooplankton abundance, diversity and community structure were estimated in the seagrass beds of Awur Bay, Jepara. The samples were collected during 36 hours observation in situ, from Nopember 1994 to April 1995 and covered a total 29 species, which 16 holoplanoton, 7 meroplankton and 6 nectobenthos.

Result of a Shannon Weaver Diversity Index and Cluster Analysis based on a Bray Curtis values revealed patterns of zooplankton abundance, diversity and community structure. These are discussed with regard to sampling time and zooplankton life cycle.

The zooplankton abundances range between 6800 - 22777 individuals/m^3, with average 13698 individus/m^3, while the diversity range between 2,48 - 2,86 and cumulatively 2,93. Zooplankton abundance and community structure fluctuated due to seasonal changes, during the first two months of the research, and increasing to a stable level in April 1995. This pattern of zooplankton community structure appears to be related to the ecological capacity and hydrodynamic factors in the sampling area.

Keywords : zooplankton, seagrass, abundance, diversity, community structure, Awur Bay, Jepara.

I. INTRODUCTION

The Bay of Awur, Jepara contains seagrass beds, coral reef and mangrove marine habitats. These three types of habitat are known as nursery areas, providing shelter and food for relatively diverse fish communities (Robertson, 1980 ; Bell & Hamerlin-Vivien, 1982 ; Endrawati, 1992 ; Zainuri, 1993 ; 1994 ; 1996).

The most recent studies of Awur Bay concentred on documenting biodiversity, on the area especially seagrass, reef and mangrove areas. However little information was avalaible on plankton communities, especially

zooplankton. Zooplankton as secondary producers and primary consumers in the food web, play an important link between phytoplankton and nekton (Odum, 1971). This is likely to influence the productivity of the area.

The objective of the present study was to describe and compare the species composition of the zooplankon communities, focusing mainly on the seagrass bed, and the the relationship between community structure and environment, especially during the six month period of the seasonal change from the end of dry moonson (November and December) to rainy moonson (January to April).

II. MATERIAL AND METHODS

The Awur Bay, (110° 37' E, 6 ° 38' S) at Jepara Waters, Northern Central Java, covers an area of about 115 ha (Fig. 1). The study sites were located on seagrass beds.

Sampling was conducted at monthly intervals, with samples collected every three hours, for 36 hours (a nycthemeral cycles). Ten liters sea water were filters using a plankton net with 45 μm mesh size from 9 localities. The samples were preserved in 4 % formalin. They were identified according to Bougis (1974) ; Newell & Newell (1977) ; Pipkin *et al* (1977) Todd & Laverack (1991); Omori & Ikeda (1992).

Water quality mesurements were taken stimultaneously. The observations were carried out from November 1994 to April, 1995.

The zooplankton abundance and diversity were calculated using the Shannon Weaver Index (Digby and Kempton, 1987 ; Omori & Ikeda, 1992).

$$H = - \sum_{i=1}^{s} (ni / N \ln ni / N)$$

where :

H = Shannon Weaver Index
s = The total number of species
ni = The total number of individual species i
N = The total number of individuals

The dissimilarity index (Odum, 1971 ; Digby & Kempton, 1987) has been chosen to calculate quantitative dissimilarity, according to :

$$D_{(1,2)} = 1 - 2 W / (A + B)$$

where :

A = Number of species in sampel A
B = Number of species in sampel B
C = Number of species common to both samples

Data were subjected to agglomerative hierarchical cluster analysis using the Bray-Curtis distance method (Legendre & Legendre, 1984 ; Odum, 1971 ; Digby & Kempton, 1987) of lingkage with the Lance & William distance mesure (Digby & Kempton, 1987). A critical distance of β = - 0,25 was chosen for the designation of final cluster.

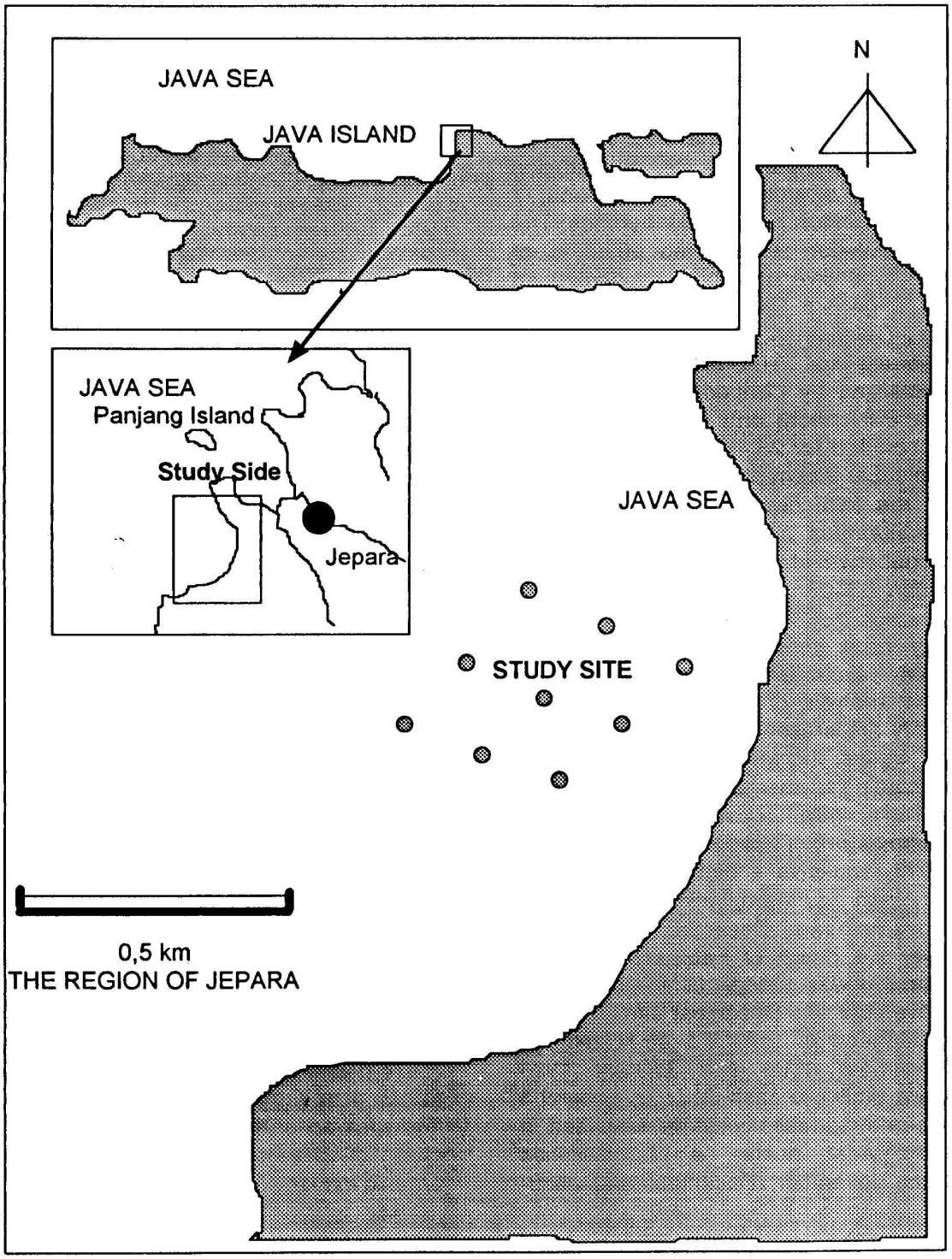

Figure 1. Location of Study Site (110° 37' E, 6 ° 38' S).

III. RESULT

The species presents and their abundances in the samples are summarized in Table 1. The 648 samplings yielded a total of 29 zooplankton species, including 16 holoplankton, 7 meroplankton and 6 nektobenthos. The holoplankton represented 60.88 % of the total diversity and was dominated by 5 genera *Centropages* sp., *Acartia* sp., *Calanus* sp., *Paracalanus* sp., and *Oithona* sp.. The meroplankton characterized by Cirripeds nauplii, Mollusca, Polychaeta and Crustacea larvae, accounted for 28.46 % of the diversity. Nektobenthos represented only 10.66% of the total diversityand characterized by *Tigriopus* sp and *Capitella* sp.. The abundance of zooplankton varied between 6800 - 22777 individus/m^3, with average 13698 individus/m^3. The diversity index showed the range between 2.48 - 2.86, with an average of 2.93. The analysis of diversity and dissimiliarity are presented in the dendrogram at figure 2, which groups samples according to their similarity. There was a high similarity between zooplankton samples taken from February and April 1995, and also a high similarity Holoplankton and Meroplankton collected in November and December 1994. However the group of February and April samples was strongly different from the November and December samples. The Nektobenthos collected at November, Desember 1994 and January 1995 were similar to each other. In general 3 group of samples could be described, a March-April cluster, a Nektobenthos from November, December and January, and a cluster with all others samples.

The water quality, i.e temperature, salinity, turbidity, dissolved oxygen, pH, current and depth are given in appendix 1.

IV. DISCUSSION

The presence of holoplankton such as *Centropages* sp., *Acartia* sp., *Calanus* sp., *Paracalanus* sp. and *Oithona* sp. in the seagrass beds of Awur Bay show that the region is dominantly influenced by the sea water current. The same results were shown by the following study : Castel (1978) at Gironde estuary, Bordeaux, South of France, Dauby (1980) in Corsica Waters Area, Boucher (1982) at Southwest of Afrika, Dessier (1983) at Tropical and Equatorial Pasific, Arinardi (1994) at Jakarta Bay and Seguin *et al* (1994) at East Albora. The water circulation also influence pattern of photosysthesis and primary productivity. Tregouboff & Rose (1957), Bougis (1974) and Dessier (1983) suggest that the presence of the genera above relate to a herbivorous feeding habit, while the presence of meroplanktonik and nektobenthos as suggested by Castel (1978) was relates to a detritivorous feeding habit. Bougis (1974), Endrawati (1992) and Zainuri (1993) also suggest that the present of *Tigriopus* sp and *Capitella* sp are indicator of the high level content of organic matter.

Table 1. Abundance (individuals / m^3) and Diversity of Zooplankton collected at 9 stations of Awur Bay, in the Northern Java Sea
(Abs. = Absolute ; Rel. = Relatif = %) from November 1994 to April 1995.

No	Taxons	Nov. 1994	Dec. 1994	Jan. 1995	Feb. 1995	March 1995	April 1995	Average	
								Abs.	Rel.
	HOLOPLANKTON								
1	*Centropages* sp.	1053	1085	813	1259	1798	822	627	10.8
2	*Acartia* sp.	556	731	722	2144	2278	3156	877	11.49
3	*Metridia lucens*	368	441	438	522	779	128	246	4.41
4	*Calanus* sp.	432	686	485	1385	1821	2636	681	8.8
5	*Eucalanus* sp.	56	150	67	38	41	67	38	0.76
6	*Temora* sp.	321	342	264	540	879	774	285	4.08
7	*Paracalanus* sp.	263	230	197	1776	1795	2926	656	7.22
8	*Microcalanus* sp.	39	54	23	31	42	161	32	0.42
9	*Anomalocera* sp.	16	32	27	31	41	67	20	0.31
10	*Eurytemora* sp.	7	26	19	50	37	52	17	0.24
11	*Labidocera* sp.	2	9	29	23	57	46	15	0.21
12	*Oithona* sp.	475	427	274	1002	980	1889	461	6.07
13	*Euterpina acutiform*	79	157	196	245	750	307	159	2.12
14	*Microstella* sp.	117	144	203	515	592	385	179	2.47
15	*Metis* sp.	0	0	0	69	104	390	51	0.45
16	*Candacia* sp.	0	64	96	219	202	179	70	0.93
	MEROPLANKTON								
17	*Autolytus* sp.	82	130	105	126	168	44	60	1.06
18	Polychaeta (Larvae)	123	87	81	438	646	1942	302	2.92
19	*Semibalanus* sp.	3	21	29	40	83	318	45	0.48
20	Cirripedia (Nauplius)	1624	1315	1088	2077	2016	948	832	14.02
21	Crustacea (Zoea)	121	180	133	425	1397	1171	313	3.49
22	Mollusca (Larvae)	741	721	398	1260	1209	1082	496	7.53
23	Branchyura (Larvae)	0	0	49	66	145	229	45	0.49
	NEKTOBENTHOS								
24	*Tigriopus* sp.	177	285	203	862	1226	831	328	4.22
25	*Laophonte* sp.	84	107	58	22	113	403	72	1
26	*Obelia* sp.	18	45	2	32	25	103	21	0.43
27	*Sagitta* sp.	30	32	25	144	399	321	87	0.92
28	*Caligus* sp.	13	9	23	38	31	56	16	0.19
29	*Capitella* sp.	0	52	150	241	815	1344	237	2.5
Kinds Total		25	27	28	29	29	29	29	
Total Individu		6800	7562	6197	15620	20469	22777	13698	
Diversity Index		2.48	2.69	2.75	2.72	2.86	2.81	2.93	

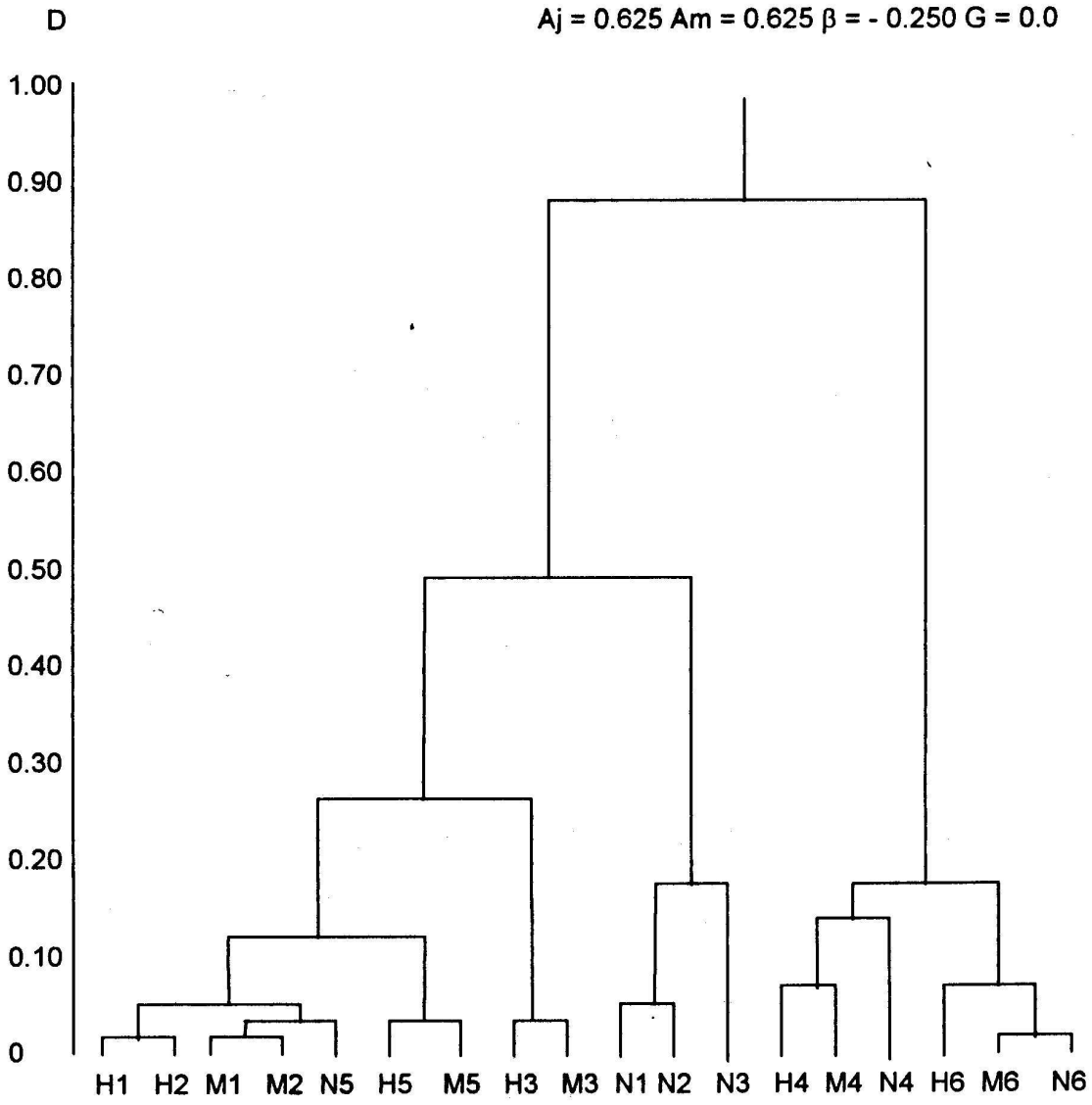

Figure 2. Dissimilarity in Taxons Composition Between The Sampling Periods. Dendrogram obtained from the data analysis base on the Bray-Curtis dissimilarity index.

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where :

D : Dissimilarity
H * : Holoplankton M * : Meroplankton N * : Nektobenthos
*1 : Sampling Period of November 1994 *4 : Sampling Period of February 1995
*2 : Sampling Period of Desember 1994 *5 : Sampling Period of March 1995
*3 : Sampling Period of January 1995 *6 : Sampling Period of April 1995

The abundance of zooplankton in the seagrass bed of Awur Bay showed a higher level of fertility compare then the 1386 - 12160 individus / m^3 reported by of Arinardi (1994) at Muara Karang, Jakarta, 1500 - 9561 individus / m^3 by Sutomo (1994) at Jakarta Bay, 30 - 3390 individus/m^3 by Arinardi *et al* (1995) at Sumatera water. The largers number recorded during this study may be due to the seagrass bed, which known as nutrient trap (Robertson, 1980 ; Bell & Hamerlin-Vivien, 1982 ; 1983 ; Endrawati 1992 ; Zainuri, 1993; 1994; 1996). The nutrient availability will be use to support the photosysthesis process of the seagrass and sufficienltly cover the zooplankton oxygen demand. The availability of the nutrient will support the need of the food and metabolism process for zooplankton lifecycles and optimize the growth (Boucher, 1982 ; Dessier, 1983; La Fontaine & Peters, 1986 ; Endrawati, 1992 ; Zainuri, 1993 ; 1994 ; 1996).

Physical parameters such as temperature, salinity, turbidity, pH and dissolved oxygen does not varry significantly between the six month, during the sampling period. While the current and depth was influenced by the seasonal change from the end of dry moonson (November and December) to rainy moonson (January to April). However, during the sampling period, the observations were conducted for a nycthemeral cycles (day and night), and caused the total zooplankton abundance change related to the changement of tide level (depth).

The diversity index showed a variation between 2,48 - 2,86 and 2,93 for the total abundance indicating that the zooplankton community structure in the seagrass bed at Awur Bay was rich without too much variation. But in this study, the weakness stated by Digby and Kempton (1987) and Moriarty (1988), that the diversity index doesn't show the change of the community structure component at the same abundance level, was apparant.

The projection of dissimilarity using the Bray-Curtis distance and Lance and William dendrogram showed 3 groups of during the study. The first group were consist of Holoplankton and Meroplankton sampling at November, Desember, February and the Nekto-benthos sampled at March. This group indicated that the community structure was in the middle of changeing related to the period of the season. The second group consisted of Nektobenthos sampling at November, Desember and January. The second group was support the indication of first group. State by Castel (1978), even there was a changement of water quality cause by the season, the benthic community structure will stay stabilize, because their tolerance were widely variated. The third group consist of the sampling period of February and April. Even the sampling period of March is not included in this group, but the zooplankton total abundance and their community structure are showed the tendency to the stabilize period, as in the change of the sampling period of November and December. This sampling period was the stabilize period and will influence the community structure on the same condition.

V. CONCLUSION

The zooplankton abundance displayed structural fluctuations due to the seasonal change, during the first

two months of the research, and increase to be stable until April 1995. Moreover, the general pattern of zooplankton community structure showed a strategy directly related to the ecological capacity and hydrodynamic factors on sampling area

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Appendix 1. Water quality patameters at 9 stations of Awur Bay, in the Northern Java Sea measure from November 1994 to April 1995.

No	Parameter	Nov. 1994	Dec. 1994	Jan. 1995	Feb. 1995	March 1995	April 1995
1	Temperatur (° C)	28-30	28-30	28-30	28-29	28-29	28-29
2	Salinity (° / oo)	31-32	31-32	30-31	30-31	30-31	31-32
3	Turbidity	Bottom	Bottom	Bottom	Bottom	Bottom	Bottom
4	Dissolved Oxygen (ppm)	5.3-6.1	5.3-6.0	5.4-6.2	5.2-6.2	5.4-6.4	5.4-6.
5	pH	7.2-8	7.3-7.8	7-7.8	6.8-7.6	6.8-7.6	7-7.8
6	Current (cm / sec.)	32-41	28-40	32-45	30-48	33-47	30-45
7	Depth/Water Lever (cm)	65-150	62-153	76-160	75-155	65-162	70-165