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THE ABUNDANCE OF ZOOPLANKTON AS SECONDARY PRODUCER AT AWUR BAY IN THE NORTHERN CENTRAL JAVA SEA

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ABSTRACT

The diversity of zooplankton (as Secondary Producer) were observed at seagrass, mangrove and coral reef area at Awur Bay, in Jepara Waters. The observation were made from August, 13 to September, 10, 2000, at four daily intervals : at 09.00 A.M., 12.00 noon ,3.00 P.M. and 6.00 PM.

The zooplankton abundance at the seagrass area are 3373–6497 individuals/m^3 with an average of 5329 individuals/m^3, at the mangrove area 4132–5970 individuals/m^3 with an average of 5177 individuals/m^3, and at the coral reef area 3061–4079 with average of 3599 individuals/m^3. The zooplankton diversity at the seagrass area are 2,1594–2,2917, with an average of 2,2289, at the mangrove area 2,0925–2,4962 with an average of 2,5130 and at the coral reef area 1,9227–2,1181 with an average of 2,0306. On the basis of the zooplankton abundance and diversity at seagrass, mangrove and coral reef area of the Awur Bay, the averages at the Jepara Waters can be regarded as an indicator of marine productivity. The three locations observed displays a direct interrelation as the habitat of zooplankton.

Keywords : zooplankton, seagrass, mangrove, coral reef, Awur Bay - Jepara.

I. INTRODUCTION

The typology of coastal ecosystem in Indonesia were diversified. Kartawinata & Soemadihardjo (1976) ; Nontji (1987) ; Rokhmin Dahuri *et. al.* (1996) state that there are several ecosystems and resources in the coastal region with high productivity. In addition, Rokhmin Dahuri *et. al.* (1996), remarked that the three elements of the natural ecosystem in coastal region such as seagrass beds, coral reef and mangrove, known as nursery areas, provide shelter and food for relatively diverse fish communities (Robertson, 1980 ; Bell & Hamerlin-Vivien, 1982 ; Endrawati, 1992 ; Zainuri, 1993 ; 1994 ; 1996 ; Zainuri & Endrawati, 1999).

The secondary producer were denoted as heterotroph biotas which transfer the organic compound from one trophic level to another (Pipkin *et. al.*, 1987). While Bougis (1974), Newell & Newell (1977) and Omori & Ikeda (1992) stated that the zooplankton or plankton animal consist of heterotrophs biota which graze on primary producers and do not have the ability to synthesize with organic matter from the environment (phagotropic). Zooplankton as secondary producer and primary consumer in the food web plays 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 determine the abundance and diversity of zooplankton as secondary producer at the seagrass bed, mangrove and coral reef of the Awur Bay, Jepara waters.

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II. MATERIAL AND METHODS

The Jepara Waters is located at 110° 37' E, 6° 38' S. This area consists of several types of ecosystem, three of which are dominant, namely seagrass bed, mangrove and coral reef. The seagrass beds cover the area along the coastal line of the Awur Bay' while the mangrove area is located at Bandengan Waters. The coral reefs area is covers the area from Kartini beach to Panjang island. These three locations were chosen as the study sites, as shown in Figure 1.

Sampling was conducted three times, on August 13 and 27 ,and September 10, 2000, with the samples collected at 08.00, 12.00, 15.00 and 18.00. Twenty five liters of sea water from 3 locations were filtered using a 45 µm mesh size plankton net. 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 (Temperature, Salinity, Dissolved Oxygen and Current) measurements were taken simultaneously.

The zooplankton abundance and diversity were calculated using the Shannon Weaver Index (Digby & 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
N = The total number of individuals

III. RESULT

The species of zooplankton present and their abundances in the samples are summarized in Table 1, 2 and 3 (Figure 2). The observations yields a total of 22 zooplankton species, with the following details : 22 species were found in the seagrass beds, 19 species in the mangrove area and 15 species in the coral reefs. Four species, *Centropages* sp., *Acartia* sp., *Oithona* sp and Cirripedia dominated between 8–27 % respectively of the total zooplankton collected. This was followed by Poly-chaeta, Mollusc larvae and *Calanus* sp., the relative abundance of which is between 3–21,5 %.

The abundance of zooplankton collected at the seagrass bed area is between 3373-6497 individuals/m^3, with an average of 5329 individuals/m^3 (Table 1), while the abundance of zooplankton collected at the mangrove area is between 4132–5970 individuals/m^3 ,with an average of 5177 individuals/ m^3 (Table 2). The lowest zooplankton abundance was shown in the coral reef area, ranging between 3061-4079 individuals/m^3, with an average of 3599 individuals/m^3 (Table 3).

With reference to sampling, the zooplankton abundance collected at 09.00 ranged between 3096-6497 individuals/m^3, while the zooplankton abundance collected at 12.00 ranged between 3173–6913 individuals/m^3 and the zooplankton abundance collected at 15.00 ranged between 3212–6014 individuals/m^3. The sample of zooplankton abundance collected on 18.00 showed a range between 3061–5600 individuals/m^3.

The diversity of zooplankton collected at the seagrass beds is between 2.1594–2.2917 , with an average of 2.2289 (Table 1), in the mangrove area 2.0925–2.4962, with an average of 2.0513 (Table 2) , in the coral reef area 1.9227–2.1181 , with an average of 2.0306 (Table 3).

The measure of water quality, as well as temperature, salinity, dissolved oxygen, and current velocity is presented in table 4.

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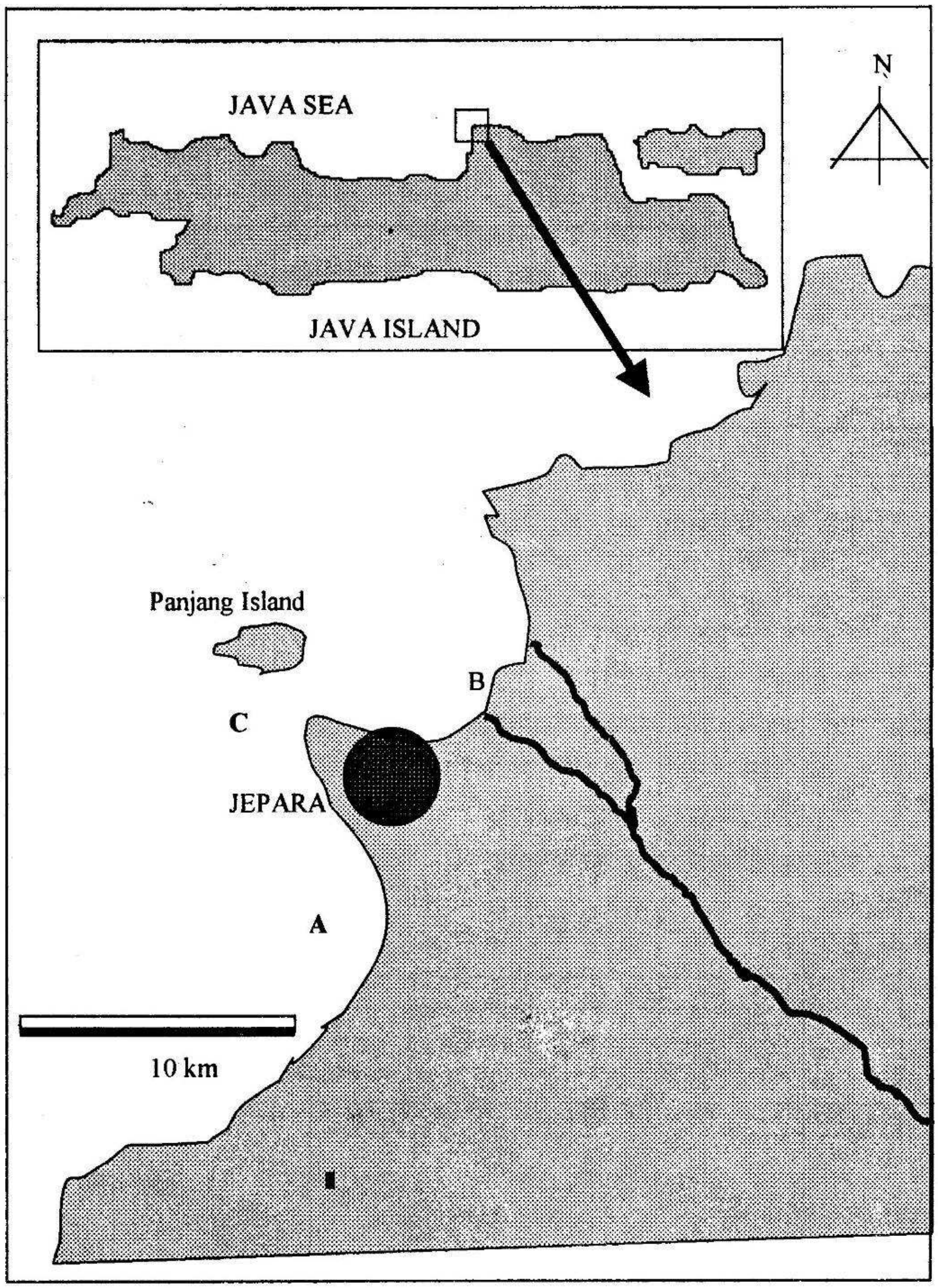

Figure 1. The Study Site (110° 37' E, 6 ° 38' S), A (Seagrass Beds), B (Mangrove) and C (Coral Reefs)

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Table 1. Zooplankton Abundance (individuals / m^3) and Diversity in Seagrass Bed (A), Jepara Waters, collected at August, 13 and 27 ; and September, 10, 2000 (Abs. = Absolut ; Rel. = Relatif = %).

No	Taxons	August, 13, 2000				August, 27, 2000				September, 10, 2000				Average	
		09.00	12.00	15.00	18.00	09.00	12.00	15.00	18.00	09.00	12.00	15.00	18.00	Abs.	Rel.
1	*Centropages* sp.	956	1012	924	657	837	952	956	555	732	990	885	469	827	16
2	*Acartia* sp.	604	754	614	501	529	584	569	423	462	607	526	358	544	10
3	*Metridia lucens*	257	264	260	194	135	109	130	110	118	113	120	93	159	3
4	*Calanus* sp.	568	598	455	352	497	622	421	297	435	647	390	251	461	9
5	*Eucalanus* sp.	109	115	83	80	95	120	77	68	83	124	71	57	90	2
6	*Temora* sp.	215	198	168	159	188	106	156	134	165	110	144	114	155	3
7	*Anomalocera* sp.	25	22	24	18	0	0	0	0	0	0	0	0	7	0
8	*Eurytemora* sp.	5	2	0	0	0	0	0	0	0	0	0	0	1	0
9	*Labidocera* sp.	5	6	2	2	0	0	0	0	0	0	0	0	1	0
10	*Oithona* sp.	645	669	595	492	564	696	551	416	494	724	510	351	559	10
11	*Euterpina acutiform*	48	52	37	35	12	17	19	22	0	0	0	0	20	0
12	*Candacia* sp.	92	85	89	68	81	88	83	57	70	92	76	49	78	1
13	Polychaeta (Larvae)	214	198	208	158	187	206	192	134	164	214	178	113	181	3
14	*Semibalanus* sp.	5	5	0	0	4	5	0	0	4	5	0	0	2	0
15	Cirripedia (Nauplius)	1795	2014	1773	1436	1571	1458	1465	1213	1374	1165	1357	1025	1471	28
16	Crustacea (Zoea)	154	139	82	94	135	145	76	79	118	150	70	67	109	2
17	Mollusca (Larvae)	627	654	583	469	549	680	540	396	480	707	500	335	543	10
18	Branchyura (Larvae)	2	0	0	0	2	0	0	0	2	0	0	0	0	0
19	*Tigriopus* sp.	124	94	89	112	109	98	82	95	95	102	76	80	96	2
20	*Laophonte* sp.	27	17	20	12	24	18	19	10	21	18	17	9	18	0
21	*Obelia* sp.	12	8	5	6	0	0	0	0	0	0	0	0	3	0
22	*Capitella* sp.	8	7	3	3	7	7	3	3	1	3	3	2	4	0
Total Kind		22	21	19	19	18	17	16	16	17	16	15	15	21	
Total Individu		6497	6913	6014	4849	5524	5910	5338	4013	4818	5773	4925	3373	5329	100
Diversity Index		2.2917	2.2289	2.2103	2.2455	2.2204	2.2175	2.1754	2.1984	2.2043	2.2435	2.1594	2.1764	2.2289	

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6	*Temora* sp.	215	198	168	159	188	106	156	134	165	110	144	114	155	3
7	*Anomalocera* sp.	25	22	24	18	0	0	0	0	0	0	0	0	7	0
8	*Eurytemora* sp.	5	2	0	0	0	0	0	0	0	0	0	0	1	0
9	*Labidocera* sp.	5	6	2	2	0	0	0	0	0	0	0	0	1	0
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21	*Obelia* sp.	12	8	5	6	0	0	0	0	0	0	0	0	3	0
22	*Capitella* sp.	8	7	3	3	7	7	[illegible]	3	1	3	3	2	4	0
Total Kind		22	21	19	19	18	17	16	16	17	16	15	15	21	
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8	*Eurytemora* sp.	5	2	0	0	0	0	0	0	0	0	0	0	1	0
9	*Labidocera* sp.	5	6	2	2	0	0	0	0	0	0	0	0	1	0
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14	*Semibalanus* sp.	5	5	0	0	4	5	0	0	4	5	0	0	2	0
15	Cirripedia (Nauplius)	1795	2014	1773	1436	1571	1458	1465	1213	1374	1165	1357	1025	1471	28
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22	*Capitella* sp.	8	7	3	3	7	7	3	3	1	3	3	2	4	0
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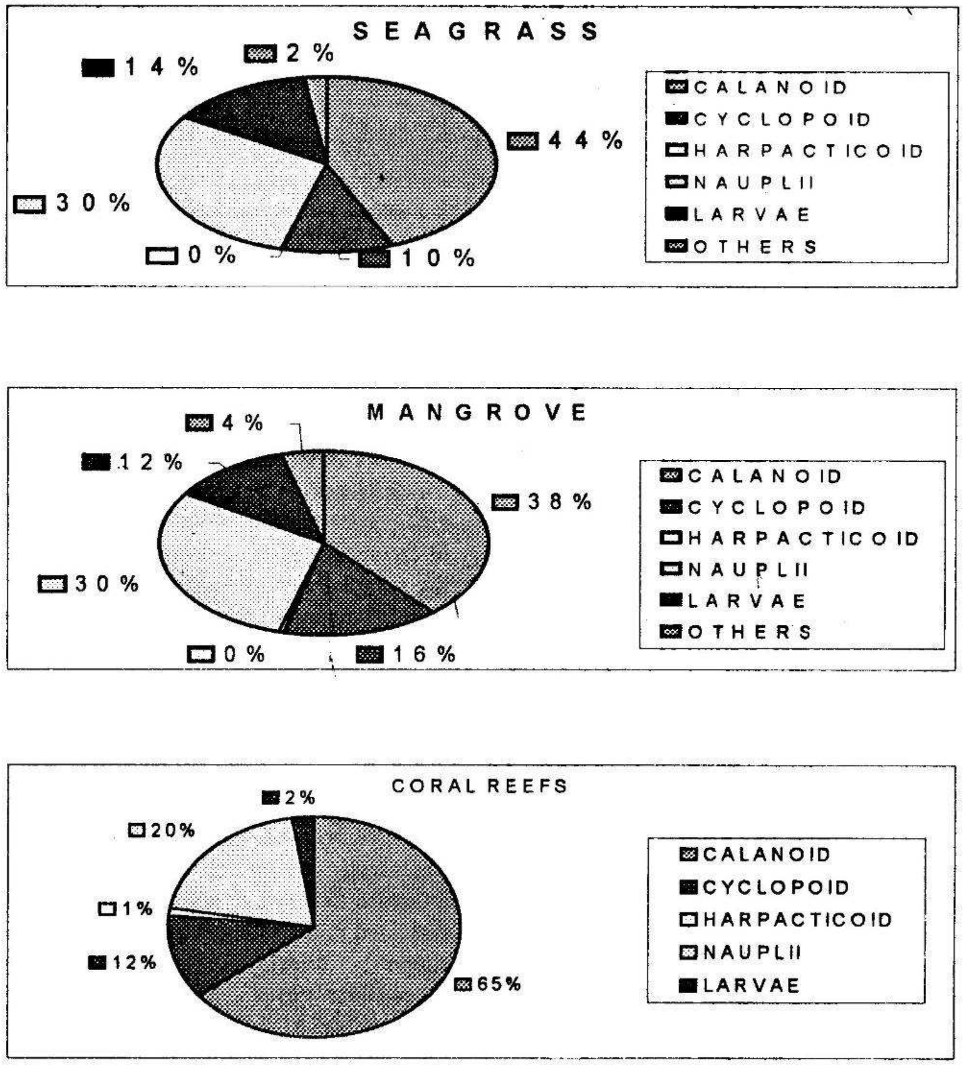

Figure 2. The relative abundance of zooplankton in Seagrass Beds, Mangrove and Coral Reefs in the Jepara Waters.

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Table 4. The water quality range measured at three study sites of the Jepara waters on August 13 and 27 ; and September, 10, 2000.

No	Parameters	August, 13, 2000	August, 27, 2000	September 10, 2000
1	Temperature (°C)	31 – 32	29 - 32	30 – 32
2	Salinity (^{o}/ oo)	29 – 32	29 - 34	28 – 34
3	Dissolved Oxygen (ppm)	5,1 – 7,6	5,5 – 7,8	5,5 – 6,9
4	Current Direction	Southeast	Southeast	Southeast
5	Current Intensity (cm/second)	20 – 30	15 - 28	20 - 30

III. DISCUSSION

The domination of *Centropages* sp., *Acartia* sp., *Oithona* sp., Cirripedia, Polychaeta, Mollusc larvae and *Calanus* sp. shows that the environmental resource of the three locations observed (seagrass beds, mangrove and coral reefs), support their life cycle. In general, the determination of productivity on the basis of the zooplankton abundance could not eliminate the life cycle and type of zooplankton itself. Two criteria of zooplankton based on the life cyle which is holoplankton and meroplankton, were illustrated by the dominant species. *Centropages* sp., *Acartia* sp., *Oithona* sp and *Calanus* sp represent the existence of species which are known as secondary producers, while the presence of Cirripedia, Polychaeta and Mollusc larvae show the presence of the primary consumer, which will develop adult biota, benefiting the presence of food at three locations of study. Stated by Odum (1971) and Bakus (1990), on the basis of trophic level criteria, the zooplankton was the important chain at the second level trophic of the food chain or food pyramid of marine productivity. Zainuri & Endrawati (1999) found the same phenomena, which depicted a mass balance trophic flow model at the same location.

The zooplankton abundance in the three locations studied showed a range which is not so much different from each other, although the figures were very low in the coral reef area compared to those in the seagrass bed and mangrove areas. The high abundance of zooplankton in the seagrass bed and mangrove areas were possibly due to the stock of organic and inorganic matters of the study sites. The seagrass bed of Jepara waters was found at Awur Bay, which is known as the final resting place of sediment deposit brought by the current and trapped by the seagrass. The high density of this deposit will influence the organic and inorganic matters dissolved in the water, which at the end will support, direct and indirectly, the zooplankton growth. The same phenomena were studied by Endrawati (1992), Zainuri (1993, 1998), Endrawati & Zainuri (1996, 1997), which proved the existence of the dissolved material and their relation to the secondary productivity. The same phenomena were also found at the mangrove area. Known as a productive area, the abundance of zooplankton of this region was directly related to the existence of organic matter. State by Sasekumar *et. al.* (1992), the prevailing view of mangrove-offshore interactions is that mangrove export large quantities of detritus to estuarine and near shore waters. The lower quantity of zooplankton at the coral reef area possibly due to the diminution of coral reef population and bleaching, especially at Panjang island. Sumich (1990) and Kasiyan Romimohtarto & Sri Juwana (1998) stated that the zooplankton abundance of coral reef related directly to the quantity of biota (primary producer) symbion of the coral reef. The diminution of the biota symbion on coral reef surface will of also influence the quantity of zooplankton.

The abundance of zooplankton observed were based on e daily cycle (light intensity); the result of this observation, proved the relationship between the phytoplanton as primary producer and zooplankton as secondary producer (Odum, 1971). The three study sites observed showed the same phenomena as well as their diversity. The diversity of zooplankton showed a direct inter-relation of the three locations observed as a habitat. This condition has been underlined by Rokhmin Dahuri *et. al.* (1998), who found that seagrass bed, mangrove and coral reef, are the productive area of the coast water, which related directly, especially in the tropical region.

IV. CONCLUSION

The zooplankton abundance at the seagrass area was 3373–6497 individuals/ m^3, with an average of 5329 individuals/ m^3, at the mangrove area 4132–5970 individuals/ m^3, with an average of 5177 individuals/m^3 and at the coral reef area 3061–4079 individuals/m^3, with an average of 3599 individuals/m^3.

The zooplankton diversity at the seagrass area was 2.1594–2.2917 , with an average of 2.2289 ; in the mangrove area 2.0925–2.4962, with an average of 2.5130 and in the coral reef area 1.9227–2.1181 with an average of 2.0306. The zooplankton abundance and diversity can be utilized as the indicator of marine productivity and at the same time can display a direct inter relation between the three locations observed as a habitat of zooplankton.

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