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Configuration of the Phytoplankton Community in the Banda Sea, Central Maluku

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Abstract: *This study aims to provide information about the Community Structure of Phytoplankton in the Banda Sea, Maluku, where these waters are fertile waters because of their relatively high nurien elements. Sampling of phytoplankton was based on the vertical haur method or vertical withdrawal and was carried out at 2 different depths, namely 250-150 m and 150-0 m at each of the 4 observation stations. Samples were taken using a phytoplankton net (Kitahara Net), then these phytoplankton samples were taken to the Marine Science Laboratory in the field of Marine Biology to be identified and classified and then counted. From the observations of the phytoplankton community, 77 species were obtained, in which 2 classes dominated at each station at 2 different depths, namely the Diatomophyceae and Dinophyceae classes, with the dominant types of phytoplankton at a depth of 150-0 m, namely Ceratium (Tripoceratium) sp. from the Dinophyceae class and Rhizosolenia alata from the Diatomophyceae class, while at a depth of 250-150 m is Ceratium (Tripoceratium) sp. The highest phytoplankton density was found at station 4a of 391510 sel.L. The results of the analysis of the phytoplankton community showed that there was variation in diversity (1.655-2.967). This situation is influenced by the relatively high availability of nutrients in the Banda Sea. Evenness (0.056-0.183) and dominance (0.045-0.305) values show no evenness and dominance of phytoplankton. The grouping analysis results show that community similarity between stations is relatively high (> 84%). The results of measurements of hydrological conditions in the Banda Sea which were observed showed that the temperature ranged from 18.3-29.28 °C and the salinity ranged from 33.79-34.00 PSU where this area corresponds to general sea waters. And from the observations of nutrients, it shows relatively high levels of nutrients which will stimulate the growth of phytoplankton cells and can increase the chlorophyll content. The grouping analysis results show that community similarity between stations is relatively high (> 84%). The results of measurements of hydrological conditions in the Banda Sea which were observed showed that the temperature ranged from 18.3-29.28 °C and the salinity ranged from 33.79-34.00 PSU where this area corresponds to general sea waters. And from the observations of nutrients, it shows relatively high levels of nutrients which will stimulate the growth of phytoplankton cells and can increase the chlorophyll content.*
Keywords: Phytoplakton, community structure, Banda Sea, Maluk

1. Introduction

The vastness of the oceans Together with the fact that humans are land creatures who naturally have limitations to enter deep waters, for many years the oceans and their communities have been safe from interference or the influence of human activities. Until the 20th century there was a technological explosion which made humans able to penetrate all parts of the ocean. The rapid growth rate of human population, accompanied by advanced technology, in a rather short decade has significantly affected the ecology of the oceans. One important part of marine waters is the diversity of marine biota whose existence depends on the condition of the availability of primary producers in the waters, namely plankton.

Nontji (1993) suggested that phytoplankton can be found in all masses of water from the surface to the depths of the waters with light intensity that still allows photosynthesis to occur. Maluku waters are one of the waters that have a very strategic value in current maritime development. This area is one of the industrial sector development areas, fisheries sector and tourism sector. In particular, knowing the fluctuation and abundance of phytoplankton in a waters is an important source of information to be able to make a quantitative estimate of the condition of fishery resources in these waters, so that the abundance of phytoplankton makes these waters a major producer of fishery production. The potential ability of a waters to produce biological resources is determined by productivity, namely the amount of organic substances that can be produced from inorganic substances through the process of photosynthesis in a certain time and volume of water. The fertility of a waters is generally determined by the level of chlorophyll content and the density and composition of phytoplankton.

Geographically, the Banda Sea has up-welling events every year. The existence of this natural phenomenon can affect oceanographic conditions, especially the productivity of plankton which can directly affect the productivity of the waters. The Banda Sea is a deep-sea waters that is still not widely known about its physical and chemical aspects as well as its blological aspects, including phytoplankton. This is because the cost of operating ships for research at sea is very expensive and uses relatively expensive and sophisticated equipment. For this reason, the Research and Development Center for Technology (BPPT) supported by the Lamont-Doherty Earth Observatory, Columbia University (New York, USA) is collaborating with LIPI and UNSRAT to conduct research in the Banda Sea.

The research objective was to identify the types of phytoplankton found in the Banda Sea, Maluku. Knowing the distribution and abundance of phytoplankton at 2 depths for each research station (250-150 m and 150-0 m). And knowing the structure of the phytoplankton community presented in the form of diversity, evenness, dominance, strategies for adapting phytoplankton and similarities between research locations.

2. Research Methods

Sampling

Phytoplankton sampling was carried out in the Banda Sea which consisted of four stations (Figure 1). Samples were taken from two different depths for each station, namely 250-150 m (b) and 150-0 m (a). Phytoplankton sampling was carried out using the vertical haul method (vertical withdrawal). Samples of phytoplankton were taken from a depth of 250-150 m and 150-0 m. The net used is a phytoplankton net (Kitahara net) (Appendix 1). To obtain samples of phytoplankton, the phytoplankton net was lowered from the Baruna Jaya IV when the ship was stationary until it reached the desired depth. Then the net is pulled vertically to the surface with a speed of 0.5 m/s.

Identification and Classification

The phytoplankton samples obtained were then identified, classified and counted at the Marine Biology Laboratory, Faculty of Fisheries and Marine Sciences, Unsrat, using a binocular microscope type 104 magnification 40 kall (10x4), 100 kall (10x10), 200 kall (10x20) and 400 call (10x40). Before being placed on the "sedgwick-rafter", the plastic container containing the sample was shaken thoroughly, 1 ml was taken with a pipette and placed on the "sedgwick-rafter" to be observed under a microscope. This observation was carried out in 3 repetitions. Then the phytoplankton samples were identified based on the books Identification of Yamaji (1982), Sournla (1986), Ricard (1987) and Chretiennot-Dinnet (1990).

Measurement of Temperature, Sallinitas and Nutrients

To measure temperature and salinity, a CTD (Conductivity Temperature Density) tool is used which is taken at a depth of 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170 , 180, 190, 200, 210, 220, 230, 240 and 250 m. As for measuring nutrients (nitrate, nitrite, phosphate and silicate) using a Van Dorn tube to take water samples at depths of 0, 10, 20, 30, 40, 60, 80, 100, 120, 160, 180 and 200 m. Furthermore, these nutrients were analyzed at the LIPI Laboratory, Ambon using a spectrophotometer.

Data analysis

(1) Calculation of filoplankton density (cells/liter), using the formula (Cleseri et al 1989):

$$E = \frac{c \times A}{fa \times V}$$

Where :
E = Density (cells/liter)
c =Total individuals observed
A = Volume of plankton concentrate (liters)
fa = Volume of plankton samples (liters)
V = Sample volume (liters)

To compare the abundance of phytoplankton cells of each type between 2 depths, namely 250-150 m and 150-0 m, Ujit (Walpole and Myers 1985) was used with the formula:

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{Sp\sqrt{(1/n_1) + (1/n_2)}}$$

$$Sp^2 = \frac{(n_1 - 1)\, S_1^2 + (n_2 - 1)\, S_2^2}{n_1 + n_2 - 2}$$

Where :
t = Calculated value

Sp = Standard deviation
n = Number of species
X = Average and to get degrees of freedom are:

$$V = n_1 + n2 - 2$$

(2) Diversity index by Shannon-Wiener in Krebs (1989):
H' =- -Σ (ni/N In ni/N)
Where :
H' = Species diversity index nl Number of individuals in species l
N = Total number of individuals
(3) Diversity Index (Ludwig and Reynolds 1988):

$$E = \frac{H'}{\ln S}$$

Where :
H' = Shannon-Wiener index for species diversity
S = Number of species
(4) Dominance Index (Odum 1996)

$$\mathbf{C = \Sigma\ (ni/N)^2}$$

Where :
ni = number of individuals or weight of each species
N = Number of individuals or individual weight of all species
(5) Frequency-Rank Graph

The distribution of phytoplankton abundance in relation to the organism's adaptation strategy to the environment was studied using the frequency-ranking chart succession method (Frontler 1976, 1977) in Figure 1.

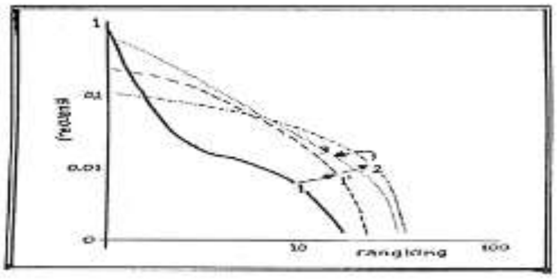

Figure 1. Graphical models of ecosystem succession (Frontier 1976, 1977, Da Silva 1979).

In the frequency-ranking graph, there are three patterns of curves, namely stages: low biological productivity, stable conditions (juvenile stage), high inter-species competition, minimum survival rate. Stage II: high blological productivity, stable condition (mature stage), low trophic competition, maximum survival rate. Stage III: decreased blological productivity, moderate trophic competition and moderate survival rate.
(6) Cluster Analysis
To see the hierarchy of phytoplankton groupings between research stations, a grouping analysis model was used which was arranged in a tree-like structure like the Dendogram hierarchy using NTSys - PC software (1992). For grouping the phytoplankton community between sampling stations (each water column sampled) the Euclidean distance is used by looking at their similarities.

3. Results and Discussion

The composition of the phytoplankton obtained from the Laboratory Identification results were 77 species for a depth of 150-0 m and a depth of 250-150 m at all stations (Table 1).

Table 1. Identified types of phytoplankton and their abundance (sel.L[1])

Tabel 1. Jenis-jenis fitoplankton yang teridentifikasi dan kelimpahannya (sel.L^{-1})

No.	Jenis-jenis	1a	1b	2a	2b	3a	3b	4a	4b
A	DIATOMOPHYCEAE								
I	**Coscinodiscaceae**								
1	*Coscinodiscus lineatus*	870							
2	*C. stellaris*	287				2614		4660	330
3	*C. jonesianus*	143							
4	*Gossleriella tropica*	1448		254		1428		1000	
II	**Asterolampraceae**								
5	*Asterolampra marylandica*	1156		1277		1428		3000	330
6	*Asteromphalus flabellatus*		2220						
III	**Thalassiosiraceae**								
7	*Porosira pseudodenticulata*					471			
8	*Planktoniella sol*	2317	887	1023				2660	330
9	*Detonula moselyana*	578				950		2000	
10	*Luderia annulata*							1000	
IV	**Melosiraceae**								
11	*Melosira nummuloides*	435	220		127		254	1330	
12	*Hyaloidiscus radiatus*	143							
13	*Endictya oseanica*								330
V	**Rhizosoleniaceae**								
14	*Rhizosolenia alata*	3913		3846	127	8807	508	71660	330
15	*R. castracanei*	143					508	8660	
16	*R. crassispina*	143		1023		3093		11000	
17	*R. imbricata*	2461	220	769	127	12614	254	20000	
18	*R. robusta*			254		10714		15660	
19	*R. setigera*	1304				7143	254	19000	
20	*R. shrubsolei*			508		28807		66660	
21	*R. stolterfothii*			508		2378		2330	
22	*R. styliformis*	2752	220	3077		12378	254	40000	
23	*Guinardia flaccida*	578				236		330	
VI	**Biddulphiaceae**								
24	*Trigonium* sp.	143		769		236		3330	
25	*Cerataulina pelagica*	287							

From the results of the analysis, it was found that the types of phytoplankton at station 1a which were abundant were Ceratium (Tripoceratium) sp. and Pyrocystis sp. At station 1b the most abundant type of phytoplankton is Ceratium (Tripopceratium) sp. and Asteromphalus flabellatus. At station 2a, the most abundant types of phytoplankton are Climacodium fraunfeldianum, Rhizosolenia styliformis and R. alata. At station 2b the most abundant type of phytoplankton is Ceratium (Tripoceratium) sp. At station 3a the most abundant types of phytoplankton are Pyrocystis sp., Ceratium (Tripoceratium) sp. and Rhizosolenia srubsolei.
At station 3b there are no abundant types of phytoplankton. At station 4a, the most abundant types of phytoplankton were Pyrocystis sp., Ceratium (Tripoceratium) sp., Rhizosolenia imbricate, R. styliformis, R. alata and R. shrubsolel.

From the results of the analysis of the number of types of phytoplankton by class for station 1a presented in Figure 3, the highest value was found in the Diatomophyceae class of 35 species and the lowest value was 1 species, each of which was in the Cyanophyceae, Chlorophyceae and Chrysophyceae classes. At station 2a which is presented in Figure 3, the highest score is 16 species in the Diatomophyceae class and the lowest value is 1 species in the Cyanophyceae and Chlorophyceae classes. At station 3a which is presented in Figure 3 the highest value is 28 species in the Diatomophyceae class and the lowest value is 1 species in the Chlorophyceae and Prymneslophyceae classes.

For the analysis of the number of phytoplankton species by class at a depth of 250-150 m, it was found that at station 1b presented in Figure 3, the highest value was 9 species in the Diatomophyceae class and the lowest value was 1 species in the Prymnesiophyceae class. For station 2b presented in Figure 3 the highest value is 5 species in the Diatomophyceae class and the lowest value is 1 species in the Chlorophyceae class. Station 3b is presented in Figure 3. The highest value is 10 species in the Diatomophyceae class and the lowest value is 1 species in the Cyanophyceae, Chlorophyceae and Prasinophyceae classes. Whereas at station 4b which is presented in Figure 3 the highest value is 7 species in the class. Diatomophyceae and the lowest value is 1 type in the class Chlorophyceae and Prasinophyceae.

Phytoplankton density
The results of the analysis of phytoplankton density at 2 depths are presented in Table 2. At a depth of 150-0 m the highest density was found at station 4a of 391510 cells. L^1 and the lowest is 25585 sel.L^1 at station 2a. While at a depth of 250-150 m the lowest density is 9507 cells.L^1 at station 1b and the lowest is 2170 cells. L' at station 2b.

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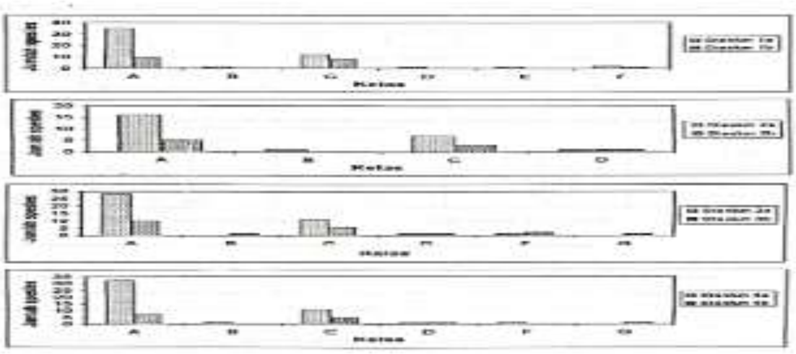


Figure 1: Graph of the number of phytoplankton species by class at each station

Information :
A = Diatomophyceae
B = Cyanonphyceae
C = Dinophyceae
D = Chlorophyceae
E = Chrysophyceae
F = Phrymneslophyceae
G = Prasinophyceae

Tabel 2. Hasil analisis kepadatan fitoplankton (sel.L^{-1}) untuk masing-masing stasiun.

	St.1a	St.1b	St.2a	St.2b	St.3a	St.3b	St.4a	St.4b
Kepadatan Fitoplankton (E)	86584	9507	25585	2170	272167	6604	391510	5610

From the results of a comparison of the abundance of phytoplankton cells of each type between the 2 depths, namely 150-0 m and 250-150 m, it was found that at stations 1 and 4 there were no significant differences, while at stations 2 and 3 there were significant differences (Table 3).

Tabel 3. Perbandingan rata-rata kepadatan spesies fitoplankton pada 2 kedalaman yang berbeda di 4 stasiun pengamatan.

STASIUN	1a	1b	2a	2b	3a	3b	4a	4b
Jumlah spesies	52	18	25	9	41	21	46	14
Rata-rata	1665,08	528,16	1023,4	241,11	6638,22	314,47	8511,09	400,71
Simpangan baku	3271,04	580,94	960,11	342,33	11570,4	110,85	15514	140,52
t. hitung Hubungan	1,48 TS		2,37 S*		2,49 S*		1,94 TS	

Keterangan : S* = berbeda nyata ($\alpha < 0,05$); TS = tidak nyata ($\alpha < 0,05$)

Indices of Diversity, Equity and Domination

The results of the analysis of diversity, evenness and dominance indices for each station based on 2 different depths are presented in Table 4. From the analysis of the diversity index (H'), the highest value at a depth of 150-0 m was 2.917 at station 1a and the value the lowest is 2.767 at station 4a. Meanwhile, at a depth of 250-150 m, the highest value was 2.967 at station 3b and the lowest value was 1.655 at station 2b.

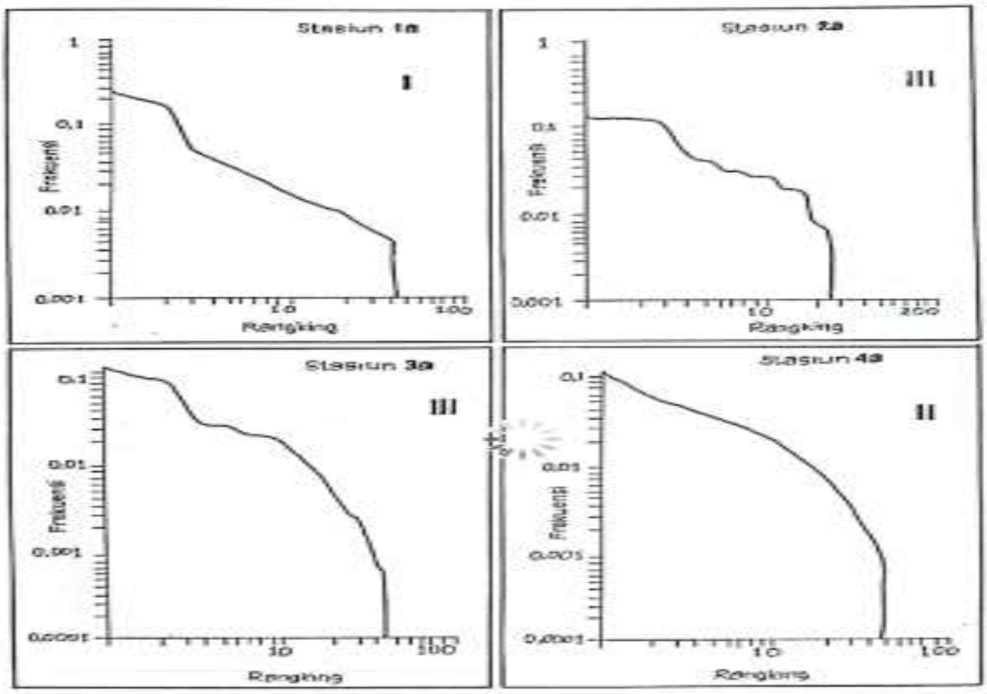
For the results of the evenness index analysis (E), the highest value at a depth of 150-0 m obtained the highest value is 0.114 atstation 2a and the lowest value is 0.056 at station 1a; while at a depth of 250-150 m the highest value was 0.183 at station 2b and the lowest value was 0.136 at station 1b. For the analysis results of dominance index (C) the highest value at a depth of 150-0 m is 0.088 at station 3a and the lowest value is 0.068 at station 28; while at a depth of 250-150 m the highest value is 0.305 at station 2b and the lowest value is 0.045 at station 3b.

Table 4. Indices of diversity, evenness and dominance of phytoplankton species for each station

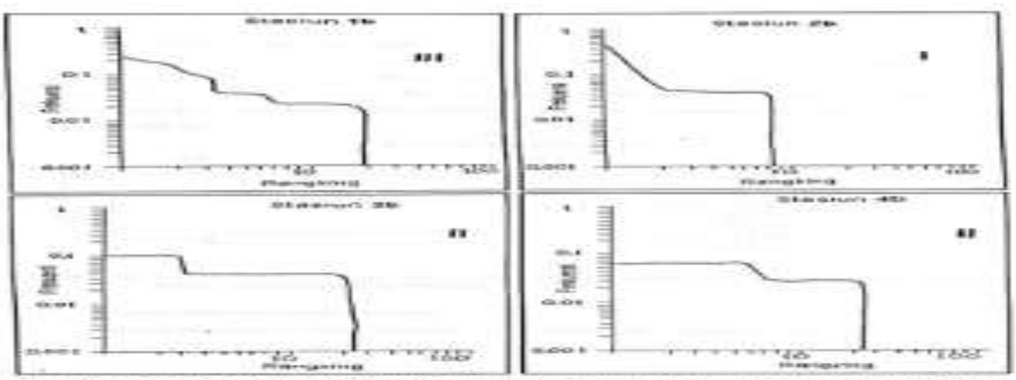
INDEKS	St.1a	St.1b	St.2a	St.2b	St.3a	St.3b	St.4a	St.4b
Keanekaragaman (H')	2,917	2,460	2,853	1,655	2,807	2,967	2,767	2,776
Kemerataan (E)	0,056	0,136	0,114	0,183	0,066	0,141	0,060	0,163
Dominasi (C)	0,088	0,115	0,068	0,305	0,089	0,045	0,086	0,058

Rank-Frequency Graph Analysis

The results of the frequency-rank chart analysis for the identified phytoplankton species based on their number at each depth are presented in Figures 4 and 5. Figure 4 shows stage I at station 1a, stage II at station 4a and stage III at stations 2a and 3a. Whereas in Figure 5 it can be seen in stage I at station 2b, stage II at stations 3b and 4b and in stage III at station 1b.



Gambar 4. Grafik rangking-frekuensi spesies fitoplankton berdasarkan jumlahnya pada kedalaman 150-0 m



Clustering Analysis

The level of similarity of the phytoplankton community in the Banda Sea, Maluku is described through a hierarchical tree presented in the form of a dendogram of clustering (Cluster Analysis) (Figure 6). It can be seen that the level of similarity of the phytoplankton community based on the number of species at each station is relatively high, more than 84%.

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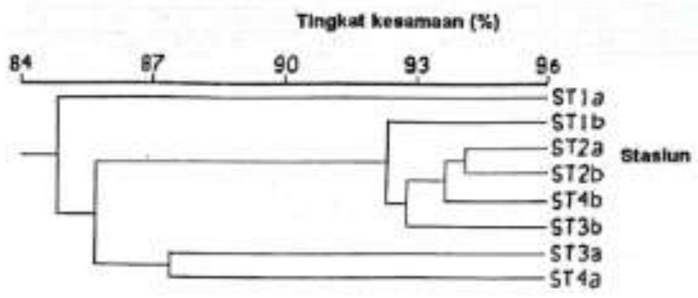

Gambar 6. Dendogram hirarki pengelompokan fitoplankton berdasarkan spesies pada masing-masing stasiun.

Temperature, Salinity and Nutrients
The results of temperature, salinity and nutrient measurements in the Banda Sea, Maluku are presented in Table 5.

Tabel 5. Hasil analisis suhu, salinitas, nitrat, nitrit, fosfat dan silikat untuk masing-masing stasiun berdasarkan 2 kedalaman yang berbeda.

	SUHU (°C)	SALINITAS (PSU)	NITRAT (μg at.NO_3 L^{-1})	NITRIT (μg at.NO_2 L^{-1})	FOSFAT (μg at.PO_4 L^{-1})	SILIKAT (μg at.SiO_3 L^{-1})
STASIUN	KISARAN	KISARAN	KISARAN	KISARAN	KISARAN	KISARAN
1a	18,3-29,28	33,39-33,94	0,99-13,66	0,43-0,67	0,28-1,28	0,92-13,39
1b	13,8-17,88	33,82-33,97	1,58-4,30	0,45-0,71	1,28-2,78	8,18-15,40
2a	17,31-29,28	33,38-33,88	0,61-22,59	0,25-0,67	0,28-1,94	2,07-28,67
2b	13,49-16,94	33,79-34,00	0,64-0,84	0,35-0,37	1,72-2,39	14,25-28,67
3a	17,98-29,15	33,41-33,90	0,85-14,34	0,12-0,45	0,11-1,00	1,67-15,66
3b	13,4-17,58	33,87-33,98	14,34-16,83	0,14-0,18	0,83-0,94	15,08-18,91
4a	18,56-29,15	33,35-33,91	1,03-12,15	0,06-0,27	0,11-0,56	2,41-9,54
4b	13,82-17,09	33,85-33,85	12,15-19,54	0,25-1,76	0,39-0,50	9,54-15,69

4. Discussion

Types of Phytoplankton
Based on the results of an analysis of the abundance of phytoplankton communities in the Banda Sea, Maluku, the most common type found was from the Diatomophyceae class which had 48 species for a depth of 150-0 m and 20 species for a depth of 250-150 m.

From the results of the analysis, the identified species that are most often found abundant or dominant at a depth of 150-0 m are Rhizosolenia imbricata, R. styliformis, R. alata, R. shrubsolei and R. robusta from the class Diatomophyceae and Ceratium (Tripoceratium) sp. and Pyrocystis sp. from the class Dinophyceae. Meanwhile, at a depth of 250-150 m, the dominant species were Asteromphalus flabellatus from the class Diatomophyceae and Ceratium (Tripoceratium) sp. from the class Dinophyceae.

The results of the above studies indicate that the most dominant types of phytoplankton, namely Cheetoceros sp. This is the same as that found at research stations in the Banda Sea, especially at a depth of 150-0 m where the genus is present at each observation station. And it turns out that in the Banda Sea the Diatomophyceae class dominates because it can utilize nutrients more quickly and also the Dinophyceae class because it can absorb nutrients and form its own food. The dominant or abundant genera are Chaetoceros spp., Ceratium (Tripoceratium) sp... Rhizosolenia spp. and Pyrocystis sp.

The genus Chaetoceros Ehrenberg, 1844 (synonyms: Bacteriastrum Shadbolt, 1853; Dicladia Ehrenberg, 1844; Paragallia Schutt, 1882), has approximately 180 species that live in the sea (only 2 species live in fresh water) and are planktonic. The genus is highly polymorphic and taxonomically highly diversified and the most represented in all the world's seas. The cells are colonial, joined in chains of more or less long, straight, curved or spiral shapes (Ricard 1987).

Phytoplankton density
The total density of phytoplankton shows that at a depth of 150-0 m the highest density is at station 4a of 391510 cells.L compared to a depth of 250-150 m the lowest is 2170 cells.L at station 2b. This is due to the deeper the depth, up to 250 m, the fewer species found, because the intensity of light received decreases, making it more difficult for the phytoplankton to carry out

photosynthesis. Whereas at a depth of 150-0 m the type of phytoplankton is abundant because it still allows photosynthesis to occur where relatively much light is received.

However, according to the t-test that at stations 1 and 4 it turns out that the pattern of distribution of temperature, salinity and nutrients is the same at the two stations, there is no significant difference between the two depths. Meanwhile, stations 2 and 3 show significant differences between the two depths, presumably because the aquatic environment is relatively different at both depths so that the adaptation of each type of phytoplankton is different. This causes the number of phytoplankton to differ at each depth at stations 2 and 3. This is identical to what was stated by Arinardi et al (1997) that phytoplankton usually gather in the euphotic zone, which is a zone with light intensity that still allows photosynthesis to occur. Groups of phytoplankton a few meters below the surface of the water,

The vertical grouping of phytoplankton is influenced by the availability of nutrients on the surface of the water. The high or low concentration of phytoplankton chlorophyll can be used as an indicator of the abundance of phytoplankton cells and also the potential for organic matter in certain waters. Also Soeroto (1993) said that phytoplankton is abundant if there are lots of nutrients or nutrients. From the observations it can be seen that the highest nitrate range occurred at station 2a, namely 0.61-22.59 µg at. NO3 L and the lowest range at station 2b is 0.64-0.84 g at. ZERO'.

Even though nitrate at stations with a depth of 150-0 m is very high, due to light as a limiting factor, the number of species is low. The higher density of phytoplankton at stations 4a and 3a compared to stations 1a and 2a is thought to be due to the lack of predation from zooplankton or other phytoplankton-eating animals.

From the results of the above research it turns out that the levels of nitrate in the Banda Sea are relatively high so that these waters are classified as fertile. At the observation station the highest phosphate range occurred at station 1b, namely 1.28-2.78 µg at. PO L and lowest at station 4b which is 0.39-0.50 jig at PO, L^1.

The analysis results in the Banda Sea waters showed that the highest silicate content range was 14.25-26.67 µg at. SIO, L^1 at station 2b and the lowest is 2.41-9.54 at station 4a, so the higher the depth the higher the level, the same as what happened in the Flores Sea and Bone Bay. So it is said that the silicates in these waters are relatively high.

The size of the silicate concentration in seawater depends on the mixing process, where this mixing process occurs due to the influence of ocean currents and river currents that empty into seawater.

Apart from nutrients, the density or abundance of phytoplankton is also affected by temperature and salinity. The results of observations show that the highest temperature range is obtained at station 1a, which is 18.3-29.28 °C and the lowest at station 2b is 13.49-16.94 °C.

From the results of the research, it was found that the temperature was relatively homogeneous in the waters of the Banda Sea at a depth of 150-0 m. This temperature is still the same as sea surface temperature in Indonesia in general and is normal for marine life including phytoplankton. From the research results, it was found that the highest salinity range at station 2b was 33.79-34.00 PSU and the lowest at station 2a was 33.38-33.88 PSU.

Salinity in Indonesian waters generally ranges from 30-35 PSU, while in the open sea it ranges from 33-37 PSU with an average of 35 PSU (Romimohtarto and Thayib 1982 in Edward and Sediadi 1999). The salinity from these observations is still in accordance with the salinity found in general waters. Thus this salinity can still support the life of marine organisms in general including phytoplankton. And in this research area there were no up-welling events because up-welling events took place periodically from late Mel to early September (Wyrtkl 1961 in Wiadnyana 1997b), whereas in this study it was conducted in October after the up-welling event occurred. Also evidenced by the surface temperature (150-0 m) for all stations is higher than the temperature at greater depths.

The results of the research above show that the abundance of the phytoplankton community in the Banda Sea is 391510 cells.L' (staslun 4a) and 272167 cells L^1 (station 3a), not because of the up-welling phenomenon but because the phytoplankton are positively phototactic (like light).

In accordance with the results of the research above, it shows that the phytoplankton community in the Banda Sea is larger than that found in the coastal waters of Southeast Maluku, especially at stations 3a and 4a compared to those found by Sediadi (1991) in the smaller Maluku Sea.

Indices of diversity, equity and dominance

Apart from showing species richness in the community, these indices also show a balance in the distribution of the number of individuals of each species (Odum 1996). From the analysis of the diversity index based on observation stations at a depth of 150-0 m, it shows a decrease from station 1a to station 4a and at a depth of 250-150 m the highest value is station 3b and the lowest is station 2b. This shows that in general, at both depths there is moderate ecological pressure for each station, because the value is between 1-3 (William and Doris in Dahuri and Suryadiputra 1985). The existence of ecological pressure is only local.

The highest evenness index at a depth of 150-0 m is 0.114 for station 2a and 0.183 at a depth of 250-150 m for station 2b. And it turns out that at these 2 different depths of sampling the phytoplankton has a very small evenness index which means it is not evenly distributed for each observation station. According to Odum (1996) the even distribution of organisms in an ecosystem means that the ecosystem is relatively stable with a greater evenness value of 0.6 which means evenly distributed. So the evenness value obtained from this study is very small (uneven) because the value obtained is below 0.6.

Based on the values from observation stations, the dominance index obtained shows that the highest value at a depth of 150-0 m is 0.089 at station 3a and the lowest value is 0.068 at station 2a while at a depth of 250-150 m the highest value is 0.305 at station 2b and the lowest value 0.045 at station 3b. This difference is thought to be due to the influence of adaptability. Types of phytoplankton against aquatic environmental conditions. In general, for all observation stations at these two different depths, there was no dominance of phytoplankton species based on number, because the value was less than 0.5.

Rank-Frequency Graph Analysis
Figures 4 and 5 show that the frequency-ranking graph at stations 1a and 2b gives a reflection of stage I where according to the criteria for that stage are low biological productivity, stable conditions (Juvenile stage), high inter-species competition and minimal survival rates. At stations 4a, 3b and 4b show the frequency-ranking graphs at stage II where the blological productivity is high, the conditions are stable (mature stage), the trophic competition is low, the survival rate is maximum.

Meanwhile, stations 2a, 3a and 1b provide stage III reflections which show that the community structure of the phytoplankton is still in a stable state, and from the ecological role of this location, the phytoplankton blological productivity has decreased and the survival rate of the phytoplankton is moderate and the trophic competition is moderate.

Clustering Analysis
The results of the inter-station grouping analysis showed that stations 2a and 2b had the highest similarity in the phytoplankton community (94%). Based on the number of species, the two stations have a similarity of phytoplankton with station 4b of almost 94%, then have a similarity of phytoplankton with station 3b close to 93%, also have a similarity of the phytoplankton community with station 1b of 92%.

In general, based on the similarity of the phytoplankton community, the observation stations were grouped into 3 groups, namely station group 1b, 2a, 2b, 4b, 3b, station group 3a and 4a and single station group 1a. By grouping stations 1b, 2a, 2b, 3b, 4b into one group, it is understood that except for station 2a, these stations are located at a depth of 250-150 m.

This is because at these stations the groups and types of phytoplankton are relatively the same. This condition is caused by light entering the waters, temperature, salinity as well as nutrients which tend to have smaller variations compared to a depth of 150-0 m.

And the grouping of stations 3a and 4a is thought to be due to the proximity of the research location compared to station 1a. Station 1a has the most distant relationship to the two previous groups because at that station there are several species that are not found at other stations.

5. Conclusions

Based on the results of observations in the Banda Sea, Maluku, it can be concluded as follows:

1. As many as 77 types of phytoplankton have been identified where 2 classes dominate at each station at 2 different depths, namely the Diatomophyceae and Dinophyceae classes. At a depth of 150-0 m the dominant types of phytoplankton are from the Dinophyceae class, namely Pyrocystis sp. and Ceratium (Tripoceratium) sp. while from the Diatomophyceae class, namely Rhizosolenia imbribata, R. styliformis, R. alata, R. shrubsolei, R. robusta and Chaetoceros spp. And the most dominant types of phytoplankton are found at station 4a. While at a depth of 250-150 m the dominant types of phytoplankton are from the Dinophyceae class, namely Ceratium (Tripoceratium) sp.
2. The highest density is at station 4a which is 391510 sel.L' and the lowest is at station 2b which is 2170 cells. L^1 and the density of phytoplankton at a depth of 150-0 m is higher than at a depth of 250-150 m.

3. The highest diversity index occurred at station 3b which was 2.967 and the lowest was found at station 2b which was 1.655; the highest evenness index was at station 2b which was 0.183 and the lowest was at station 1a which was 0.056; The largest domination index is at station 2b which is 0.305 and the lowest is at station 3b which is 0.045.
4. Rank-frequency chart analysis shows that stations 1a and 2b are stage I, stations 4a, 3b and 4b are classified as stage II and stations 2a, 3a and 1b are classified as stage III.
5. Analysis of the grouping structure of the phytoplankton community based on the number of species at each station showed a community similarity of greater than 84%.
6. Observations of temperature and salinity in the waters of the Banda Sea are relatively identical to sea waters in general, so that this area can support the life of marine organisms in general, including phytoplankton.
7. The concentration of nutrients (nitrate, nitrite, phosphate and silicate) in the waters.

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