Research Journal of Animal, Veterinary and Fishery Sciences _____ISSN 2320 – 6535
Vol. **3(10),** 17-22, December **(2015)** *Res. J. Animal, Veterinary and Fishery Sci.*

Phytoplankton Diversity in Transitional season in the Inner of Ambon Bay, Maluku province, Indonesia

Lutfi Hardian Murtiono[1], Sutrisno Anggoro[2], Dwi P Sasongko[3]
[1]Dept. of Environmental Science, Diponegoro University, Jl. Imam Bardjo SH, Semarang, Central Java, 50241, INDONESIA
[2]Dept. of Fisheries and Marine Science, Diponegoro University, Jl. Prof. Soedarto SH, Semarang, Central Java, 50275, INDONESIA
[3]Dept. of Sciences and Mathematics, Diponegoro University, Jl. Prof. Soedarto SH, Semarang, Central Java, 50275, INDONESIA

Available online at: www.isca.in, www.isca.me
Received 25th November 2015, revised 15th December 2015, accepted 24th December 2015

Abstract

Research on the community structure of phytoplankton in transitional seasons have been conducted in the Inner of Ambon Bay in Maluku province, Indonesia. Forty-nine species of phytoplankton are identified with the group of diatoms Bacillariophyceae dominated the plankton community. The species which dominated are Chaetoceros sp., Trichodesmium sp., Rhizosolenia sp., Ceratium sp., Nitzschia sp. and Navicula sp. The abundance of phytoplankton is range between 2.335 cells L^{-1} – 37.252 cells L^{-1}.

Keywords: Inner of Ambon Bay, phytoplankton, abundance.

Introduction

Feasibility condition of a body of water for aquaculture development activities knows the level of fertility and pollution of waters. One of the parameters used as an indicator is phytoplankton community structure. In aquatic ecosystems, phytoplankton have a very important role as a basic life aquatic organisms such as fish, oysters and crustaceans, besides that they also have a role in aquatic ecosystems to absorb heavy metals, toxic material, nutrients and then converted into a simpler form[1]. Phytoplankton community structure in waters is also related to the availability of phytoplankton as a food chain and its function as a natural food needed by aquatic organisms including fish farming. In addition to the balance of the ecosystem as an estimator parameter, plankton is also a provider of food for the fish.

Phytoplankton as a natural food source for the larvae and juveniles, especially fish and oyster. Phytoplankton also acts as a producer of oxygen in the waters. Environmental changes will affect the community structure of phytoplankton in the waters. The main factors that cause environmental change in coastal waters are tidal and season, especially seasonal changes cause the freshwater input into the estuary area[2]. Besides that, the waste input into waters could be the factors that influence and exert pressure on the aquatic environment (ecological stress).

Phytoplankton is low-level plants that are planktonic, drifting live in the water column. Phytoplankton as primary producers that make up the food chain in estuaries and marine region, which directly or indirectly assist in the production of fish and other animals that live in it. In a case of eutrophication and inorganic contamination as a result of the activity of human activities both on land and at sea, it will have an impact on marine productivity and fisheries in the region. Plankton respond to any changes that occur in the environment, especially changes in organic matter[3]. Water quality change is closely related to communities and structure of plankton that can provide a picture of the condition of these waters. The ecosystems with low diversity and unstable and susceptible to the influence of external pressure compared with the ecosystem that has a high diversity[4].

Ambon Bay is an important part of the Ambon Island and its divided become two parts, namely outer and inner bay, where it's separated the threshold of Galala - Rumahtiga with its depth between 9-13 meters. Inner of Ambon Bay categorized semi-enclosed and estuaries[5]. Inner of Ambon Bay is located at 128° 11' 29" E up to 128° 19' 25" E and 3° 37' 40" S to 3° 39' 50" S. These waters have 11.52 ha area and maximum depth reaches 41 m. As the estuaries, Inner of Ambon Bay has the ecological function as a source of nutrients and organic matter are transported through the circulation ups and downs, as a provider of habitat for a number of animals that depend on estuaries as shelter and feeding grounds, and as a source of production and a growing fish and other aquatic organisms[6].

Several previous studies indicate a tendency of environmental degradation on the Ambon Island. The impact of development and the increase of population and land clearing affected the Ambon Bay including the resources available in this ecosystem, ie phytoplankton. Eutrophication problems of increased levels of nutrients, ie phosphates and nitrates that come from household waste that can exceed normal conditions[7–9]. This study aims to determine the abundance and the succession of phytoplankton in the Inner of Ambon Bay in over a period of transitional season.

Material and Methods

Phytoplankton sampling conducted during transitional seasons on May 2015 in the Inner of Ambon Bay, Ambon, Maluku province, Indonesia. Sampling was conducted in nine locations have been determined by purposive (table-1). Samples of phytoplankton have been collected from nine stations in the Inner of Ambon Bay.

Plankton samples were collected from the surface water and about 25 L of water was filtered using plankton net of mesh size 25 µm and mouth's diameter 30 cm. Phytoplankton samples were collected in sterile glass bottles and fixation of the samples was done in situ with 4% formalin. The phytoplankton samples were determined in the laboratory using compound microscope type *Nikon Eclipse 50i* with camera. The numerical count was done by adopting Sedgwick-Rafter Cell method and counted by field count method[10]. The phytoplankton were determined using the following identification keys:[11,12].

Shannon Wiener Diversity Index was used to determine diversity of phytoplankton species[13], $H' = \sum p_i . \ln(p_i)$, in which H' is the diversity index, pi is the proportion of the amount of individuals of each species. If diversity index is less than 1, it means the diversity of phytoplankton is low. The diversity index between 1 and 3, it means the diversity is moderate and if diversity index more than 3, it means the diversity is high. Pielou's Evenness Index[13] was used to calculated the evenness of phytoplankton community, $E = H'/\ln S$, where H' is the Index diversity of Shannon Wienner, ln is the natural logarithm and S is the amount of species. The evenness index constrained between 0 and 1. The Simpson Index (D) is a diversity measurement which takes into account both evenness and also richness[13], $D = \sum(n/N)^2$ where n is the amount of species, N is the amount of all species. The value of D ranges between 0 and 1. With this index, 0 represents infinite diversity and 1, no diversity. That is, the bigger the value of D, the lower the diversity.

Table-1
Sampling stations

Station	Location	Latitude	Longitude
1	Galala	03°39'30,10"	128°12'26,90"
2	Poka	03°39'13,20"	128°12'01,60"
3	Batu Koneng	03°38'30,20"	128°11'57,60"
4	Halong	03°39'09,41"	128°13'00,94"
5	Waiheru	03°38'17,65"	128°12'34,45"
6	Hunuth	03°38'12,20"	128°12'55,34"
7	Lateri	03°38'23,35"	128°14'24,31"
8	Nania	03°38'09,93"	128°13'39,17"
9	Passo	03°37'56,61"	128°14'19,96"

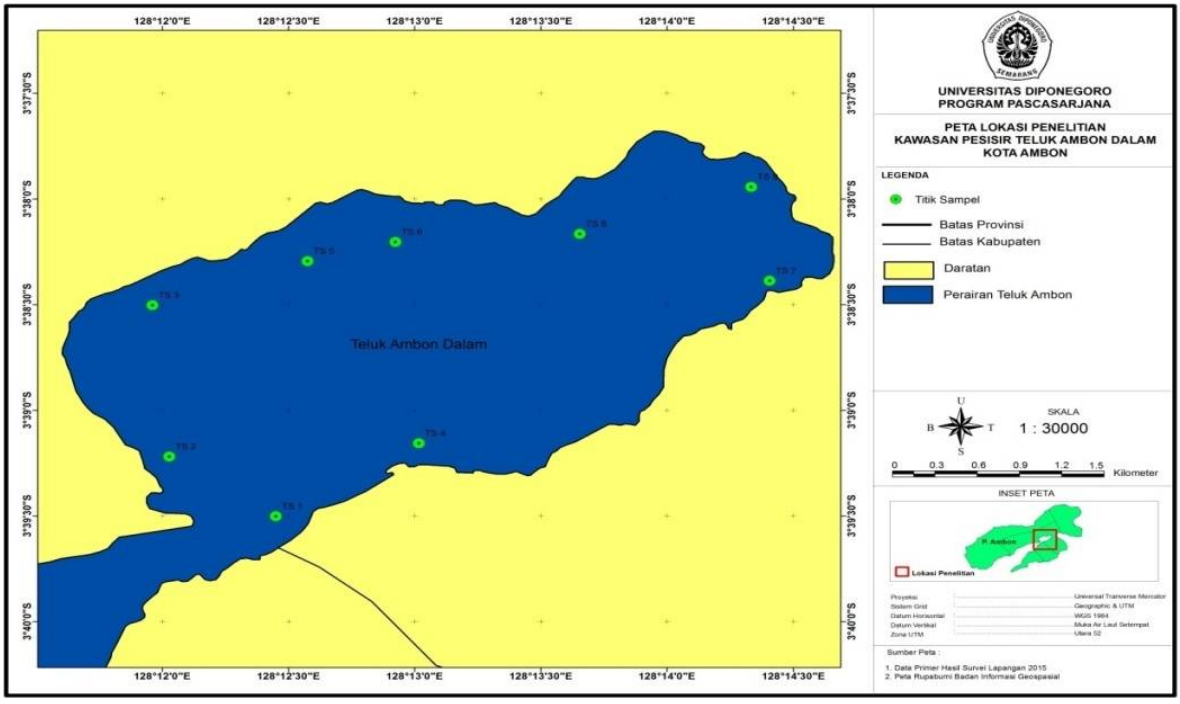

Figure-1
Study area

Result and Discussion

The result of the research showed the abundance of phytoplankton ranging from 2,335 to 37,252 cells Liters^{-1}, with an average of 13,040 ± 11,480 cells Liters^{-1}. The highest abundance of phytoplankton was found in Station 6 (Waiheru) and the lowest in Station 1 (Galala). Results of analysis of the composition of phytoplankton at nine observation stations, acquired 49 phytoplankton species are divided into four classes, namely Bacillariophyceae (diatoms) with 27 number of species, Cyanophyceae with three number of species, two species of Chlorophyceae and Dynophyceae with 10 species. The dominated species were *Chaetoceros* sp., *Trichodesmium* sp., *Rhizosolenia* sp., *Ceratium* sp., *Nitzschia* sp. and *Navicula* sp. The composition of phytoplankton found in each observation station shown in figure-2.

Domination of diatoms has been known as in some previous research[8,9,14,15]. Bacillariophyceae or diatoms dominate at all observation stations with the predominant species are *Chaetoceros* sp, *Nitzschia* sp and *Navicula* sp. This indicates that the class Bacillariophyceae can adapt to any environment [16]. In the previous study in the same location shows the composition of diatom group in the range of 33.33 to 100% of the type commonly found is Nitzschia sp., Coscinodiscus sp. and Bacteriastrum sp[9]. There were two dominant species of diatoms in the Bay of Ambon group in which *Thalassionema nitzschioides* and *Planktoniella sol*[15]. The dominance of the class Bacillariophyceae in Ambon Bay occurred in any season in which the growth of diatoms *Trichodesmium* occurred in the east season[7]. Phytoplankton predominant in Ambon Bay were *Chaetoceros* sp., *Thalassionema* sp., *Nitzschia* sp., *Rhizosolenia* sp., *Thalassiosira* sp. and *Trichodesmium* sp[8].

Shannon-Wiener diversity index (H'), Pielou evenness index (E) and Simpson dominance index (D) is used to assess the stability of the community of aquatic organism in relation to the condition of a body of water (table-1) Shannon-Wiener diversity index (H') indicates the range of 0.82 to 1.38. The highest diversity index that station 4 (Halong), whereas at station 1 (Galala) had the lowest diversity index. Based on the Shannon-Wiener diversity index, the diversity in the station 3, 4, 5 and 6 were moderate. While at stations 1, 2, 7, 8 and 9 shows the index diversity was low. Evenness index value (E) is calculated by Pielou Evenness Index showed that the distribution of individuals among species is not evenly distributed. The evenness index value range is from 0.25 to 0.39, it shows the uneven distribution of phytoplankton species in Ambon Bay. Simpson dominance index (D) of phytoplankton in Inner Bay of Ambon showed the range of 0.40 to 0.67. The range value indicated that there was no particular type of phytoplankton that dominates in the extreme in the waters of the bay. In the existence of Ambon Bay that is surrounded by residential areas have an impact on the high organic matter into the waters as a result of household waste. As the estuaries, the Inner Bay of Ambon is very susceptible to pollution domestic waste and this has led to the disruption of water including phytoplankton communities, which acts as the primary producers of food webs[17].

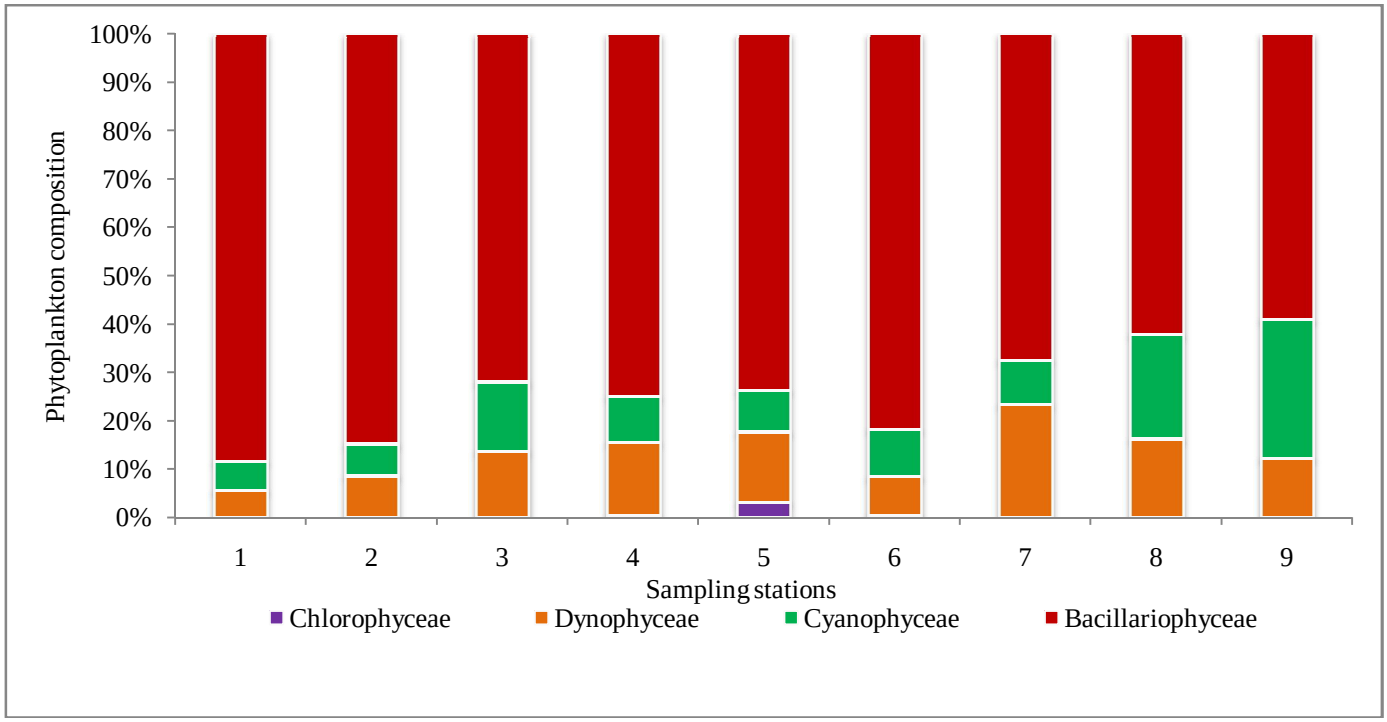

Figure-2
Composition of phytoplankton

Table-2
Number of species, abundance, diversity index, evenness index, and dominance index

Station	Number of species	Abundance (cells L^{-1})	H'	E	D
Station 1 (Galala)	23	2,335	0.82	0.26	0.67
Station 2 (Poka)	32	4,746	0.97	0.28	0.60
Station 3 (Batu Koneng)	35	11,253	1.20	0.34	0.48
Station 4 (Halong)	34	17,807	1.38	0.39	0.40
Station 5 (Hunuth)	33	23,367	1.08	0.31	0.57
Station 6 (Waiheru)	38	37,252	1.13	0.31	0.52
Station 7 (Lateri)	26	2,835	0.96	0.29	0.58
Station 8 (Passo)	31	6,288	0.85	0.25	0.59
Station 9 (Neg. Lama)	31	11,479	0.97	0.27	0.60

Conclusion

Bacillariophyceae diatom groups dominate community structure in the waters of the Inner Bay of Ambon in the transitional season. Forty-nine species of phytoplankton found during the research with the predominant species are *Chaetoceros* sp., *Nitzschia* sp. and *Navicula* sp.

Acknowledgments

The authors are thankful to the Ministry of Marine Affairs and Fisheries, Republic of Indonesia to support with scholarship for this study.

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Table-3
Phytoplankton population in Inner of Ambon Bay during transitional season

Bacillariophyceae	**Dynophyceae**	**Cyanophyceae**	**Chlorophyceae**
Amphora sp.	*Alexandrium* sp.	*Nostoc* sp.	*Closterium* sp.
Bacteriastrum sp.	*Amphisolenia* sp.	*Podolampas* sp.	*Zygnemopsis* sp.
Biddulphia sp.	*Ceratium* sp.	*Trichodesmium* sp.	
Chaetoceros sp.	*Dinophysis* sp.		
Coscinodiscus sp.	*Goniodoma* sp.		
Cocconeis sp.	*Gonyaulax* sp.		
Climacodium sp.	*Gymnodinium* sp.		
Ditylum sp.	*Ornithocercus* sp.		
Diploneis sp.	*Pyrocystis* sp.		
Eucampia sp.	*Pyrophacus* sp.		
Grammatophora sp.			
Guinardia sp.			
Hemiaulus sp.			
Leptocylindrus sp.			
Lauderia sp.			
Melosira sp.			
Navicula sp.			
Nitzschia sp.			
Oscillatoria sp.			
Pleurosigma sp.			
Rhabdonema sp.			
Rhizosolenia sp.			
*Stephanopyxis*sp.			
Triceratium sp.			
Thalassionema sp.			
Thalassiosira sp.			
Thalassiothrix sp.			

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