Proportion of HABs in Losari coastal waters of Makassar

by Rahmadi Tambaru

Proportion of HABs in Losari coastal waters of Makassar

R Tambaru, Y A L Nafie, and A W Junaidi

Department of Marine Science, Faculty of Marine Science and Fisheries, Hasanuddin University, Makassar, 90245

Email: aditbr69@yahoo.com

Abstract. Harmful alga blooms (HABs) are phytoplankton considered dangerous in any waters, especially when found in a large number of cells. Research on the proportion of the emergence of harmful phytoplankton (HABs) had been conducted in June until December 2018 in the coastal waters of Losari Beach, Makassar City. The method developed by APHA was used to analyze the appearance of HABs, then a proportion test. Results showed that there were seven genera detected by HABs, namely Protoperidinium, Gymnodinium, Ceratium, Prorocentrum, Gyrodinium, Gonyaulax, and Dinophysis. All genera were groups of Dinophyceae. Based on the proportion test, HABs gained 41%. This means the percentage of HABs was still low in abundance when compared to a non-HABs type. Thus, the water condition of Losari has not been worrying. However, early preventive measures have to be taken into account to prevent the growth of HABs.

1. Pendahuluan

Phytoplankton is microorganisms that can control the concentration of nutrients in marine waters [1], such as nitrogen and phosphorus type nutrients [2]. The concentrations of these two nutrients can change because they are used by chlorophyll organisms, including phytoplankton, in their activities. The need for these two types of nutrients is seen in the process of forming organic material through the process of photosynthesis. Therefore, many experts conclude, changes in the concentration of the two nutrients are related to changes in the abundance of phytoplankton.

In the sea area, the distribution and structure of phytoplankton communities vary greatly. That variation occurs because the concentration of nutrients is always changing. Changes in river water flow seasonally that flow into ocean waters cause the nutrients to experience a reduction in both spatial and temporal concentrations [3]. This affects phytoplankton activity.

An understanding of the distribution of phytoplankton is something that must be known because it can be used in explaining the status of ecosystem structure and function. For this reason, knowledge about the types of phytoplankton that develop in water must be mastered [4], likewise with knowledge concerning its diversity status. It is often used as an indicator of the sustainability of the ecological system in supporting the life of organisms, including phytoplankton.

In marine waters, phytoplankton act as a food source for organisms at higher tropic levels. However, in certain conditions, these microorganisms can actually reduce the quality of waters if the amount is excessive (blooming) [5], especially if the abundance is dangerous phytoplankton (*Harmful Algal Blooms*, HABs).

HABs is a term used in certain genera of phytoplankton that can cause death in fish and contaminate marine food (seafood) through the toxins/poisons produced [6]. However, in the case of blooming by several genera of non-toxic phytoplankton can also be categorized as HABs. If they bloom then experience mass death, this can cause the waters to become anoxic. They will be

IOP Conf. Series: Earth and Environmental Science 564 (2020) 012018 doi:10.1088/1755-1315/564/1/012018

decomposed by bacteria. In the process of decomposition, bacteria absorb oxygen as a source of energy so that dissolved oxygen will decrease rapidly and even run out altogether [7].

Of course, the presence of HABs can endanger the lives of other aquatic organisms and even humans if it is abundant in marine waters [8]. Through the food chain, the accumulation of toxins in the body of organisms that consume HABs subsequently consumed by humans can cause health problems and death [9]. In connection with this, research has been conducted which aims to analyze the proportion of the presence of HABs in coastal waters with a case study of the Losari coastal waters of Makassar City. Through this research, it is the latest information in examining the condition of Losari waters in the present and for the future.

2. Methods

2.1. Time and place

This research was conducted in March - June 2017 with a location in the Losari coastal area of Makassar City, South Sulawesi. At the location of this study, three stations were established (Figure 1). The station I represent Losari waters, Station II represents waters around POPSA, Station III is located in the waters of the island of Lae-Lae. The research activities consisted of two stages. The first stage involves taking water samples at each station. The second phase includes the identification of phytoplankton carried out at the Research Center for Brackish Aquaculture Fisheries and Fisheries Education (BRPBAP3) Maros.

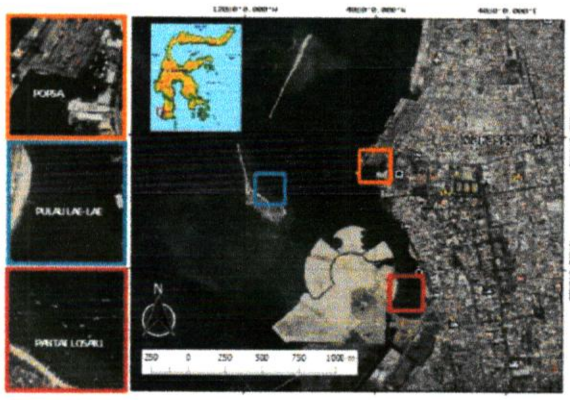

Figure 1. Research location.

2.2. Identification of phytoplankton including HABs

Enumeration of phytoplankton, including HABs, is done in the laboratory. A total of 1 ml of the water sample is put into the Sedgwick Rafter Counting Cell (SRCC). Then, the SRCC is placed on the Microscope preparation table. Through this tool, the enumeration process is carried out. Identification is carried out to the level of genus. The identification guidelines are used by identification books by Newell and Newell [10] and Yamaji [11]. The method developed by APHA [12] is used in calculating its abundance.

2.3. Data analysis

The test of One way ANOVA is used to analyze the abundance of phytoplankton with potential HABs based on station differences. To find out the proportion of abundance of fitoplankton HABs, descriptive analysis was used.

3. Results and discussion

3.1. The abundance of phytoplankton (HABs and non-HABs)

Four main classes and 34 phytoplankton genera were identified in this study. The phytoplankton class in question is Bacillariophyceae. Dynophyceae, Cyanophyceae, and Chlorophyceae. These four classes are spread in all three stations. Based on the genus, its presence in the station I was found as many as 31 genera, in station II there were 22 genera, and in station III there were 16 genera.

In general, the phytoplankton genus that often appears and has the highest abundance is the Skeletonema of the Bacillariophyceae class and Protoperidinium of the Dinophyceae class. The emergence of a genus from these two classes is something that is common in ocean waters. Specifically, the genus in the Bacillariophyceae class is a group of phytoplankton commonly found in ocean waters, which can be found from coastal waters to the ocean. Because of this ability, this genus and many other genera in the Bacillariophyceae class are used as biological indicators for uncontaminated waters. Based on the station, the phytoplankton genus that often appears and has the highest abundance in the station I is the Skeletonema of the Bacillariophyceae class with an abundance of 860 cells/L, then in Station II is Protoperidinium from the Dinophyceae class with an abundance of 571 cells/L, and at Station, III is the Skeletonema from the Bacillariophyceae class with an abundance of 271 cells/L (Figure 2). From the enumeration, Skeletonema from the Bacillariophyceae class is the most abundant genus.

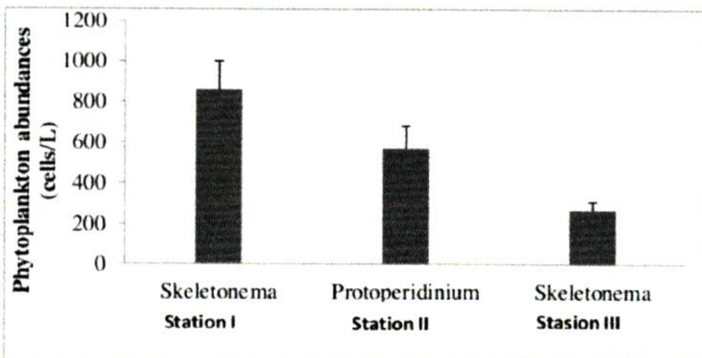

Figure 2. Genus of phytoplankton, which often appears by the station.

Based on phytoplankton enumeration, it was recorded that the abundance of phytoplankton at Station, I was found to be highest with a range between 778-1886 cells/L with an average of 1183 cells/L. Station II experienced a decrease ranging from 768-795 cells/L with an average of 793 cells/L, and station III had the lowest abundance ranging from 140-852 cells/L with an average of 456 cells/L (Figure 2). However, from the ANOVA test results at a 95% confidence interval (α = 0.05), the abundance of phytoplankton by the station was not shown a significant difference. This means that the abundance of phytoplankton between stations is considered the same.

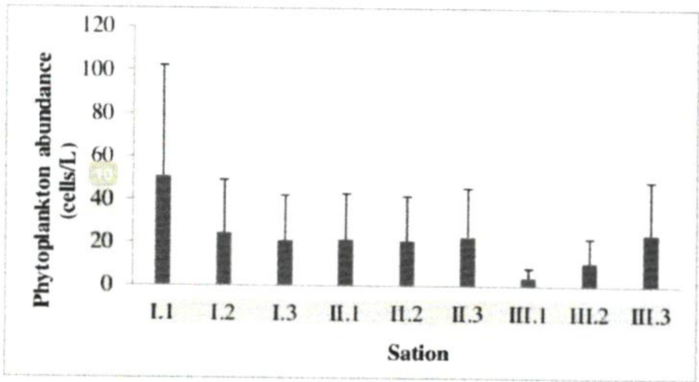

Figure 3. Phytoplankton abundance between stations (I, II, and III).

3.2. The emergence of HABs

During the study, the number of HABs detected was seven genera. The seven genera are Protoperidinium (67-314 cells/L), Gymnodinium (19-59 cells/L), Ceratium (28-216 cells/L), Prorocentrum (10-39 cells/L), Gyrodinium (10 cells/L), Gonyaulax (10-29 cells/L), and Dinophysis (10-29 cells/L). The whole genera are Dinophyceae class groups, spread in all three research stations. Genera can have a negative effect on human health and the ecosystem.

Based on the station, seven genera of HABs were found in Station I, namely Protoperidinium, Gymnodinium, Ceratium, Prorocentrum, Gyrodinium, Gonyaulax, and Dinophysis, five genera at Station II namely Protoperidinium, Gymnodinium, Ceratium, Prorocentrum, and Gonyaulax, and five genera at Station III namely five. Protoperidinium, Gymnodinium, Ceratium, Gonyaulax, and Dinophysis. Of the total genera, as many as four HABs genera are scattered throughout the stations, namely Protoperidinium, Gymnodinium, Ceratium, and Gonyaulax.

3.3. Proportion test of phytoplankton Non-HABs and HABs

A proportion test is performed at each station to detect the comparison between the abundance of non-HABs phytoplankton and HABs. Based on the analysis, the proportion of phytoplankton abundance that causes HABs at stations I, II, and III is 56%: 44%, 61%: 39%, and 83%: 17%, respectively. The test results explain that the type of phytoplankton that is not HABs has a proportion that is still higher when compared to the type of HABs. This means that the quality of phytoplankton at the study site is still categorized as good even though there are indications of the emergence of HABs.

If we look at the development of HABs, the station I show the highest proportion of HABs abundance when compared to stations II and III. The reason that can be given is that it is possible because the location of the station is close to the mainland (around which there is a lot of human activities such as food stalls along Losari Beach) and tends to be closed and lacks new water changes (flushing) from other parts of the sea waters. Praseno and Sugestiningsih [13] explained that the abundance of phytoplankton in abundance was caused by human activities from the mainland, which made a contribution in the form of organic matter and then entered the sea. The effect of this activity decreases with increasing distance from land. This can be seen at the station farthest from the mainland, namely station III, the proportion of HABs at this station was recorded at only 17%.

Based on the test proportion of the abundance of HABs at all stations obtained a value of 41% (Figure 4). This means that the abundance of HABs is still lower when compared to types that are not HABs. The low proportion of HABs abundance shows that the condition of the Losari coastal waters of the city of Makassar is still not worrying even though measures must be taken to prevent the development of the HABs themselves. Thus, these waters are still considered suitable to be inhabited by other aquatic organisms. One step that can be taken so that the HABs are not growing (blooming) is to provide awareness to the public not to throw garbage into the waters of the coast of Losari and surrounding areas.

HABs genera can become dominant if nutrients or other physical water-chemical factors optimally support their growth. According to Livingstone [14], genera in the Dinophyceae class, including HABs, can flourish and dominate waters when the main nutrients such as nitrate and phosphate are in very high concentrations. At the same time, genera from the Dinophyceae class will release certain toxins from the body. Precisely because of the poison, it can inhibit the development of other genera in different classes of phytoplankton.

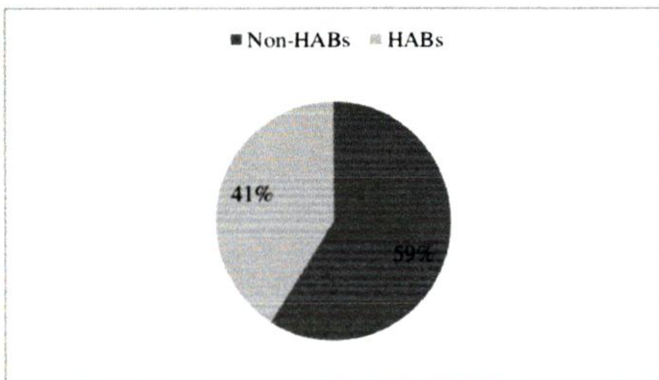

Figure 4. The proportion of phytoplankton abundance of HABs.

From the observations, not all genera from the Dinophyceae class have the potential to develop rapidly, only a few genera such as Protoperidinium and Ceratium. In other genera, it is not yet worrying because of its low abundance. However, observing its development is important to be carried out continuously so that the emergence of HABs genera can be detected from time to time. To note, they can survive when environmental conditions do not support growth. They can form a cyst (cysta) to wrap themselves as a resting stage. The formation of cysts (cysta) is part of their life cycle in environmental conditions that do not support growth. The cyst then settles to the seabed and rests until environmental conditions support it to develop. When water conditions support growth, such as an extremely high concentration of nutrients [15], they can develop rapidly in a short time [16], [17].

In this study, genera from the Dinophyceae Class were ranked second after genera from the Bacillariophyceae class. As explained earlier, the Dinophyceae class genera that always appear at each station are Protoperidinium, Gymnodinium, Ceratium, and Gonyaulax. These four genera can thrive under conditions of different nutrient variations, ranging from low to high concentrations. Because of that ability, they are able to compete with other genera. But in this study, the four genera did not show signs of blooming because their abundance had not exceeded $>10^6$ cel/L [18].

Protoperidinium can produce toxins of the Azaspiracids type. The character of the poison is almost similar to DSP (Diarrhetic Shellfish Poisoning) poison, which can cause nausea in sufferers in 3-5 days. Ceratium and Gonyaulax are actually less dangerous, but if growth is very dense, it can reduce oxygen concentration (Anxious), causing mass death [19]. Gymnodinium is a genus that causes PSP (Paralytic Shellfish Poisoning) problems that produce Saxitoxin poison.

Of the several types of non-HAB phytoplankton that need to be aware of is the Skeletonema of the Bacillariophyceae class. The genus abundance has exceeded 1000 cells/L and appeared at each station. Skeletonema can be dangerous if blooming because it can clog the respiratory apparatus in aquatic biota [20].

3.4. Ecological index of phytoplankton

The results of the ecological index analysis during the study are presented in Table 1. Diversity index values (H ') for each station I, II, and III are 2.36, 2.29, and 2.05, respectively. Based on these index values, Losari coastal waters have moderate diversity and phytoplankton stability ($1 \leq H' \leq 3$). In such conditions, the growth and development of phytoplankton genera are not optimal. That causes diversity, and stability is classified as moderate. It is possible that some environmental parameters are not in the appropriate range for growth.

Table 1. Ecological index of phytoplankton.

Station	Diversity index	Uniformity index	Dominance index
I	2.36	0.79	0.15
II	2.29	0.82	0.15
III	2.05	0.88	0.16

Uniformity index values (E) for each station I, II, and III are 0.79, 0.82, and 0.88, respectively. This shows that the phytoplankton genera have relatively high uniformity ($0.6 \geq E \leq 1.0$). According to Odum (1971), if the diversity index value is close to 1, then the uniformity index (E) is categorized high. This shows that the number of individuals in each genus is considered to be the same or evenly distributed. The research location is considered to be feasible and in accordance with the growth of various phytoplankton genera. The feasibility and suitability have implications for the dominance index values (D) of each station I, II, and III, respectively are 0.15, 0.15, and 0.16, where those values indicate that there is no phytoplankton genus that dominates at the study site. It can be said that the three research stations are considered to be still in accordance with the growth of various phytoplankton genera.

4. Conclusion

In the end, it was concluded, there were seven HABs genera detected in this study, namely Protoperidinium, Gymnodinium, Ceratium, Prorocentrum, Gyrodinium, Gonyaulax, and Dinophysis. All of these genera are the Dinophyceae group. Based on the proportion test, HABs have a percentage of 41%. This shows that the abundance of phytoplankton HABs is still lower when compared to non-HABs phytoplankton. Thus, the condition of the Losari coastal waters is still considered feasible to be inhabited by other aquatic organisms. However, early preventive measures must be considered so that HABs does not progress.

References

[1] Jennerjahn T C, Ittekkot V, Klöpper S, Adi S, Nugroho S P, Sudiana N, Yusmal A and Gaye-Haake B 2004 Biogeochemistry of a tropical river affected by human activities in its catchment: Brantas River estuary and coastal waters of Madura Strait, Java, Indonesia *Estuar. Coast. Shelf Sci.* **60** 503–14.

[2] Lagus A, Suomela J, Weithoff G, Heikkilä K, Helminen H and Sipura J 2004 Species-specific differences in phytoplankton responses to N and P enrichments and the N: P ratio in the Archipelago Sea, northern Baltic Sea *J. Plankton Res.* **26** 779–98.

[3] Andersen J H, Schlüter L, and Ærtebjerg G 2006 Coastal eutrophication: recent developments in definitions and implications for monitoring strategies *J. Plankton Res.* **28** 621–8.

[4] Effendi H, Kawaroe M, Lestari DF, and Permadi T 2016 Distribution of phytoplankton diversity and abundance in Mahakam Delta, East Kalimantan *Procedia Environ. Sci.* **33** 496–504.

[5] Parmar T K, Rawtani D, and Agrawal Y K 2016 Bioindicators: the natural indicator of environmental pollution *Front. Life Sci.* **9** 110–8.

[6] Abo-Taleb H 2019 Importance of Plankton to Fish Community *Biol. Res. Aquat. Sci.*

[7] Nontji A 2006 *Tiada kehidupan di bumi tanpa keberadaan plankton* (Lembaga Ilmu

Pengetahuan Indonesia, Pusat Penelitian Oseanografi).
[8] Carmichael W W 2014 *Human health effects from harmful algal blooms: a synthesis* (International Joint Commission's Health Professionals Advisory Board).
[9] Berdalet E, Fleming L E, Gowen R, Davidson K, Hess P, Backer LC, Moore S K, Hoagland P, and Enevoldsen H 2016 Marine harmful algal blooms, human health, and wellbeing: challenges and opportunities in the 21st century *J. Mar. Biol. Assoc. The United Kingdom* **96** 61–91.
[10] Newell G E and Newell R C 1977 Marine Plankton–a practical guide. Hutchinson & Co *Publ. Ltd, London.*
[11] Yamaji I E 1979 Illustration of The Marine Plankton of Japan (Osaka. Hoikusha Publishing Co.)
[12] Association A P H 1992 Water Pollution Control Federation *Stand. methods Exam. water wastewater* **15.**
[13] Praseno D P and Sugestiningsih 2000 *Retaid di perairan Indonesia* (Pusat Penelitian dan Pengembangan Oseanologi-LIPI).
[14] Livingstone D R 2001 Contaminant-stimulated reactive oxygen species production and oxidative damage in aquatic organisms *Mar. Pollut. Bull.* **42** 656–66.
[15] Obi F O, Ugwuishiwu B O and Nwakaire J N 2016 Agri Wastes **35** 957–64.
[16] Sellner KG, Doucette G J, and Kirkpatrick G J 2003 Harmful algal blooms: causes, impacts, and detection *J. Ind. Microbiol. Biotechnol.* **30** 383–406.
[17] Polat S, Akiz A, and Olgunoglu M P 2005 Daily variations of coastal phytoplankton assemblages in summer conditions of the northeastern Mediterranean (Bay of İskenderun) *Pakistan J. Bot.* **37** 715.
[18] Sidabutar T 2006 Bencana akuatik di perairan Teluk Jakarta tragedi bulan Mei 2004 *Prosiding Seminar Nasional Tahunan III Hasil-hasil Penelitian Perikanan dan Kelautan, Fakultas Pertanian, UGM, Yogyakarta.*
[19] Wiadnyana N N 1996 Mikroalga berbahaya di perairan Indonesia *Oseanologi dan Limnol. di Indones.* **29** 15–28.
[20] Aryawati R, Bengen D G, Prartono T and Zulkifli H 2016 Harmful Algal in Banyuasin Coastal Waters, South Sumatera *Biosaintifika J. Biol. Biol. Educ.* **8** 232–9
[21] Odum E P 1971 Fundamentals of ecology. WB Saunders Co *Philadelphia and London* **546.**

36

Proportion of HABs in Losari coastal waters of Makassar

ORIGINALITY REPORT

15%	14%	10%	14%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.e3s-conferences.org Internet Source	3%
2	www.frontiersin.org Internet Source	2%
3	multisitestaticcontent.uts.edu.au Internet Source	1%
4	Ali Fadel, Lama Salameh, Malak Kanj, Ahmad Kobaissi. "Evolution of primary production and its drivers on the Lebanese coast between 1986 and 2013", Limnological Review, 2020 Publication	1%
5	A Steckbauer. "Ecosystem impacts of hypoxia: thresholds of hypoxia and pathways to recovery", Environmental Research Letters, 04/01/2011 Publication	1%
6	smujo.id Internet Source	1%
7	journal.unnes.ac.id	

36 RT

Internet Source

1%

8	Submitted to University of the West Indies	Student Paper	1%
9	academic.oup.com	Internet Source	1%
10	studylib.net	Internet Source	1%
11	Submitted to Kingston University	Student Paper	<1%
12	rjls.ub.ac.id	Internet Source	<1%
13	Submitted to Universitas Hasanuddin	Student Paper	<1%
14	think-asia.org	Internet Source	<1%
15	Mahatma Lanuru, Rohani Ambo-Rappe, Khairul Amri, Susan L. Williams. "Hydrodynamics in Indo-Pacific seagrasses with a focus on short canopies", Botanica Marina, 2018	Publication	<1%
16	ejournal.stipwunaraha.ac.id	Internet Source	<1%

psasir.upm.edu.my

17	Internet Source	<1%
18	Submitted to Hamdan Bin Mohammed Smart University Student Paper	<1%
19	bioflux.com.ro Internet Source	<1%
20	Elena V. Anufriieva, Gamal M. El-Shabrawy, Nickolai V. Shadrin. "Copepoda in the shallow hypersaline Bardawil coastal lake (Egypt): Are there long-term changes in composition and abundance?", Oceanological and Hydrobiological Studies, 2018 Publication	<1%
21	archimer.ifremer.fr Internet Source	<1%
22	"Proceeding of the 1st International Conference on Tropical Agriculture", Springer Science and Business Media LLC, 2017 Publication	<1%

Exclude quotes Off
Exclude bibliography Off
Exclude matches Off