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**Research Article**

# SPECIES COMPOSITION AND BIODIVERSITY OF PLANKTON IN SOME MARICULTURE AREAS AT BARRU DISTRICT INDONESIA

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**A B S T R A C T**

Mariculture is overgrowing along with the decrease in a marine catch. It is expected to be the largest supplier of marine and fishery sectors. Improvement effort of mariculture activities will be further encouraged including efforts to optimize its other roles as conservation areas. This study is conduct in Barru waters from February 2017 to November 2018. The purpose of this study is to determine biodiversity, composition, abundance of plankton. Methods used for this study was observation at the mariculture's site, and then the unidentifiable samples would be taken to the laboratory for further identification. The conclusion are 1) The composition of the phytoplankton found the diatom class (Bacillariophyceae) consisting of 29 species and Dinophyceae 4 species. Zooplankton dominated by crustacean class composed of 10 species, and other species is from Cirripedia class, one species. 2). The highest value of the diversity index found at station II (floating net cage location) that is 2.82. For the zooplankton which only found at seaweed had a diversity index of 2.26. The highest value of uniformity index for phytoplankton found in station II, that is 0.94. While for zooplankton in observation station, value index is of 0.94 which indicate that value tends to stabilize.



## INTRODUCTION

Barru waters are coastal areas that have the potential for plankton. Under these conditions, Barru waters have an abundance of aquatic species ranging from fish species, shellfish, snails and others. The role of plankton in the waters both phytoplankton and zooplankton is significant in the marine ecosystem because plankton becomes food for many species of marine organisms. Also, most of the marine microorganisms started their life as plankton, especially at the stage of eggs and larvae (Nontji, 2007) while the spread of plankton in the waters is influence by phototaxis. The movement of plankton is influence by phototaxis. Phytoplankton is a positive phototaxis and zooplankton is negative phototaxis (Sachlan, 1982).

Zooplankton community structure was dominated by the group of diatoms, such as *Coscinodiscus*, *Chaetoceros*, *Guinardia*, *Navicula. Pseudonitzshia.* The genus *Ceratium* (the group of dinoflagellates) was found in relatively abundant, but still normal condition. The structure of macroplankton was dominated by copepods 23938 individual/m3 (67.73 %) (Thoha. 2007).

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The abundance of phytoplankton was quite varied with relatively large number of 22 species. Cyanophyta was observed with relative high occurrence. The total abundance of phytoplankton in the study sites was still in optimum condition with the values ranging from 22093-29514 cells.$L^{-1}$ and its productivity rate categorized as moderate (Femy *et al*. 2017). There was a significant correlation ($P<0.01$) between zooplankton abundance as well as biomass with salinity, dissolved oxygen and chlorophyll-*a*. Based on PCA (Principal Component Analysis), the most important factors in mudflat shallow river–estuarine system that could describe most changes of biomass and abundance of zooplankton were salinity, chlorophyll-*a*, temperature and pH, respectively (Farhadian and Pouladi. 2014).

An abundance of plankton greater than $10^4$cell.$L^{-1}$ was found in diatom group (*Nitzschia* sp*., Thalassiosira* sp., *Chaetoceros* sp., *Fragillaria* sp., *Thalassiothrix* sp., and *Melosira* sp.) and non-litoral group (*Oscillatoria* sp. and *Spirogyra* sp.). The abundance of those species indicated the algal bloom phenomenon. *Dinophysis* sp. was also identified, which was harmful alga blooms (Setiabudi *et al*, 2016). Aryawati *et al*. (2014) found 41 genera of phytoplankton, consisted of family Bacillariophyceae (26 genera), Dinophyceae (7 genera) Cyanophyceae (7 genera) and Chlorophyceae (1 genus). The highest number of genera was recorded while low tides in November (24 genera), and the lowest was on May while high

tides (16 genera). The highest abundance of phytoplankton was recorded in August during high tides (2,68 x $10^7$ cell.$M^{-3}$), and the lowest was in May during high tides (6.59 x $10^5$ cell.$M^{-3}$). The diversity index (H'), the uniformity index (E), and the dominance index (D) ranged between 0,64-3; 0,15-0,71, and 0,15-0,83, respectively.

Choiru *et al*. (2015) was held to correlate between abundance and community structure index of phytoplankton found in studied areas with water quality by correlation analysis. The highest abundance was determined 16550 cell/L which was belonging to *Nitzschia closterium*. Deversity index was ranged from 0,58 to 1,44 while similarity indexes ranged from 0,66-0,89, and dominance index was 0,29-0,61. The correlation analysis indicated a significant positive relationship between abundance, diversity and similarity index with seawater temperature and DO.

Increased productivity is associated with the transient in flux of nutrients, El Nino conditions in the warm pool, or surface nutrients in HNLC waters. Under these conditions there seems to be a small increase in the relative abundances of Synechococcus, diatoms and chlorophytes. Grazing of picophytoplankton by macro-grazers may make an important contribution to the 'biological pump', which may not be dominated by large phytoplankton such as diatoms (Mackey *et al*. 2002).

Sidabutar *et al*. (2016), the results showed that the abundance of phytoplankton ranged from 40x$10^6$ cells/L up to 1699.1x$10^6$ cells/L, with the highest counts during the east monsoon in 2010 and the lowest during the first transition period of 2011. The predominant phytoplanktons were frequently diatoms such as *Skeletonema*, *Chaetoceros* and *Thalassiosira*. The distribution of phytoplankton seemingly follows the nutrient concentration ratio where phosphate acted as the limiting factor and nitrogen as the triggering factor. The higher the N/P ratio, the more potentially uncontrolled growth of phytoplankton occurred. When the availability of nutrients increased an increase in total algal biomass occurred, however, the alteration in nutrient composition led to a change in composition of community.

A total of 203 phytoplankton species were identified from seven algal divisions. Seasonal differences in the quantitative and qualitative composition of the phytoplankton communities in the different sites were marked. Nutrient concentrations and phytoplankton abundances were found to be poorer than those of many other areas along Egyptian coast. The Shannon-Wiener Diversity Index classified Matrouh water as being between clean and moderately polluted, whereas the water quality indicator (WQI) demonstrated that it was between good and excellent. It can be concluded that the index based on WQI is currently more suitable than the phytoplankton species index for assessing the quality of the water of the Matrouh beaches (Gharib *et al*. 2011).

Romimohtarto (1999) stated that Crustaceans overlooks the waters of eastern Indonesia is the zooplankton of the crustacean class.Tidal affected the distribution of marine organism, the vertical and horizontal movement of plankton that caused a distribution of plankton was different between places (Cardoso *et al*. 2014).This high ammonia content caused by domestic waste disposal and supply from the river and it can affect the growth of the plankton (Periyanayagi *et al*., 2007; Bahaar and Bhat, 2011).

DO level in the waters is proper for plankton's growth (Ramakrishna. 2014); Nowrouzi and Valavi, 2011; Fathi *et al*., 2009; Dong *et al*., 2015; Luyiga and Kiwanuka. 2003). Water temperatures recorded in the three stations still regarded as proper temperature for plankton's growth.

According to Prescott (1970); Siva Sankar and Padmavati (2012) the optimum temperature for diatom growth is 30$^o$C. Current condition in Barru waters showed evolving in various mariculture activities. Seaweed cultivation, floating net cages and pearl cultivation can almost be found in every location in Barru waters.

Based on the above description, it is considered necessary to conduct the study on biodiversity, density, and dominance of plankton associated with the mariculture area to become a source of information for stakeholders (government, entrepreneur and academics).

The result of the study will provide empirical pictures of; First, that mariculture areas can provide sustainable benefits to the surrounding environment if well managed by ecosystem-based approaches. Secondly, from the theoretical side, this study will add academic discourse that mariculture area can also be a conservation area to boost fishery production, Third, from the policy side, this study will become one of the references of sustainable cultivation activities.

This study aims to determine species composition and biodiversity of plankton in some mariculture areas.

## RESEARCH METHODS

### *Time and place*

This research was conduct in Makassar Strait of Barru waters of South Sulawesi for two year (February 2017 – September 2018). The station one is on 4032'23.8524" S and 119035'14.3304" E (red circle), The Station two is on 4016'44.1552" S and 119036'20.1672"E (yellow circle. The Station three is on 4014'20.274" S and 119036'51.8616"E (purple circle) . This location was chosen because it has variation and diversity of mariculture activities.

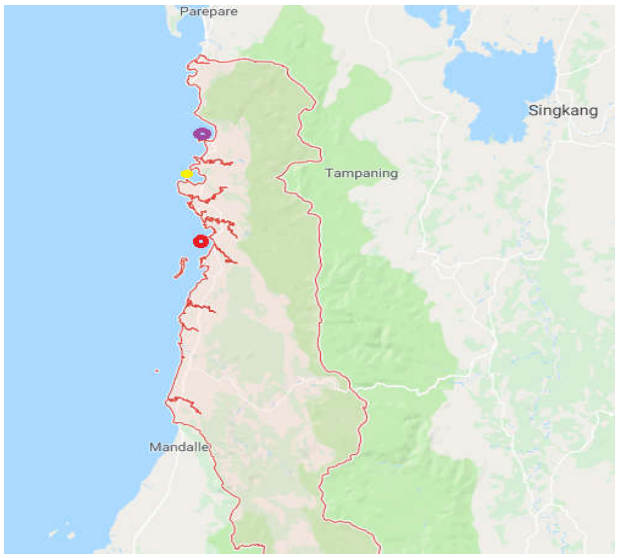


**Figure 2** Map of the location the research (red, yellow and purple circle)

## MATERIALS AND TOOLS

The materials and tools to be used in the study are described in Table 1 below:

**Table 1** Materials and research tools

| No | Tools and Materials (unit) | Quantity | Utility |
|---|---|---|---|
| | **(At) the field study** | | |
| 1. | Thermometer ($^{o}$C) | 1 Unit | Measure the temperature |
| 2. | Secchi Disk (meter) | 1Unit | Measure the clarity |
| 3. | Hand Refractometer (‰) | 1 Unit | Measure the salinity |
| 4. | pH meter | 1 Unit | Measure the pH |
| 5. | DO meter (ppm) | 1 Unit | Measure the dissolved oxygen |
| 6. | Global Positioning System | 1 Unit | Determining the sampling position |
| 7. | Cool box | 1 Unit | Sample container |
| 8. | Floating Droudge | 1Unit | Measure current velocity and current direction |
| 9. | Dip stick (cm) | 3Unit | Measure the depth |
| | **Laboratory** | | |
| 10. | Spectrophotometer (ppm) | 1 Unit | Measures the content of nitrate, phosphate, and chlorophyll-a |
| 11. | Filter paper (0,45µm) | 40 pieces | Filtering water samples |
| 12. | Desiccators | 1 Unit | A place to cool the sample |
| 13. | Measuring cup (250 ml) | 20 Unit | Place of water samples |
| 14. | Analytical balance (mg) | 1 Unit | Weigh the sample |
| 15. | Oven | 1 Unit | Dryer |
| 16. | Vacuum pump | 1 Unit | Filtering chlorophyll-a and MPT |
| 17. | SPSS 21 Programme | - | For linear regression analysis |

***Measurement and Sampling***

***Determination of Sampling Points***

Determination of the location of research done by *Purposive sampling*, technique, based on consideration of researcher. The factor in determining the position of research was based on the site of the mariculture area in Barru.

***Preservation of Plankton Samples***

Conservation of plankton samples which is filtered in a plankton net *with a diameter of 30 cm, length 100 cm and mesh size 30 µm,* container bottle later transferred into a glass bottle with a dark condition and stable temperature. To keep the plankton sample well to be able to identify, the samples that had been taken, preserved first, then put into the cold box, and then can be checked in the laboratory. The preservative used is formalin 4% and add 2 drops of lugol solution to strengthen the color of plankton so that it does not fade. This preservation is intended to maintain the integrity and shape of the plankton for easy identification (Nontji, 2008).

***Observation and Identification of Plankton***

Samples of preserved plankton were taken to the Faculty of Mathematics and Natural Science (MIPA) laboratories of HasanudinUniversity to be observed and identified. Identification of plankton referred to the identification book "Marine and Fresh Water Plankton (Davis, 1955) and Invertebrate Zoology (Barnes, 1971) To make the identification more comfortable, the species of plankton observed was photographed using a digital camera.

***The Measurement of Chemical Physics is as Follows***

***Station Position***

1. Determined sampling zones.
2. Determined position and direction of the station after arriving at the specified zones using GPS. Recorded position and direction of station read by GPS.

***Temperature***

1. Inserted thermometer into the water.
2. The recorded temperature measured on the thermometer.

***Salinity***

1. Sampled sea water then dripped on hand refractometer.
2. The recorded salinity of measured salinity.

***Dissolved Oxygen***

***O2 Measurement Uses the Winkler Method as Follows***

1. Sterile sample bottle (dark bottle) was filled with sample water until full without bubbles. Added one mL of Manganous solution then be shaken.
2. Then added one mL of an alkaline solution and be shaken.
3. Then added 1mLof concentrated sulfuric acid solution and be shaken.
4. Taken 100 mL into Erlenmeyer and then titrated with thiosulfate solution until the color changes (become fade/lighter)
5. Added 5 – 8 drops of starch (to blue) and then diluted with thiosulfate solution until colorless (clear).
6. Recorded the addition of thiosulfate solution for the calculation of dissolved oxygen.

$$DO = \frac{mL\ penitar \times 0{,}16 \times 1000}{Sample\ (mL)} = \ldots. ppm$$

***Ammonia***

1. The sterile sample bottle filled with sea water then added H2SO4 as much as five drops and cooled in a cool box.
2. Taken two mL into the test tube and then added with 0.5 mL phenol solution.
3. Then added Na. Nitroprusside as much as 0.5 mL.
4. Then added oxidizer NH3 at 0.5 mL (greenish color).
5. Taken as much as one dose of spectrophotometer bottle and then record the absorbance at the wavelength of 560 nm.

$NH_3$ = 8,762 x Abs sample x 0,025 = … ppm

***Nitrate***

1. The sterile sample bottle is filled with water and then added H2SO4 as many as five drops into the cool box.
2. Taken as much as two mL into the test tube and then added with brucine as much as five drops.
3. Then add two mL of concentrated sulfuric acid in the acid room (yellowish color).
4. Taken one dosage of spectrophotometer bottle and recorded its absorbance at 420 nm wavelengths.

$NO_3$ = 6,69 x Abs sample = ….. ppm

pH (potential of hydrogen)

1. A sterile sample bottle filled with sea water then cooled in a cool box.
2. Measured 100 mL of sample water (brand Hanna Instrument). The results.

***Phosphate***

1. A sterile sample bottle filled with sea water then added H2SO4 as much as five drops and then cooled into the cold box.

2. Taken as much as two mL into the test tube and then added with two mL boric acid solution
3. Then added three mL of oxidizing solution (bluish color).
4. Taken as much as one dosage of spectrophotometer bottle and then absorb it at wavelength 620 nm.

$PO_4$ = 19,2 x Abs sample = …ppm
Primary Productivity (PP)

a. Sterile bottle sample (dark bottle) filled with seawater until full without bubbles.
b. Samples were incubated for 3 hours.
c. Added one ml of Manganous solution then be shaken.
d. Then added one ml of an alkaline solution and be shaken.
e. Add one ml of concentrated sulfuric acid solution and shaken.
f. Taken 100 $mL^1$ into Erlenmeyer then titrated with thiosulfate solution until the color change (become lighter).
g. Added 5 – 8 drops of starch until the color blue then titrated using thiosulfate solution until colorless (clear).
h. Recorded the addition of thiosulfate solution for the calculation of dissolved oxygen.

Net Primary Productivity = LB – IB
Primary Productivity of respiration = IB – DB
Gross Primary Productivity = (LB – IB) + (IB – DB)

Note: LB = Light bottle
IB = Incubation bottle
DB = Dark bottle

***Data Analysis***

***Calculation of Abundance***

Determination abundance of plankton was conduct based on the sweeping method above the object glass. Plankton abundance is expressed quantitatively in cell/ liter. Plankton abundance is calculated based on the formula (Fachrul, 2007). That is:

N = n x (Vr/Vo) x (1/Vs)
Where:
N= Number of cells per liter
n= Number of cells observed
Vr= The volume of filtered water (ml)
Vo= Water volume to be observed (ml)
Vs= Water volume strained (l)

The following formula can calculate a volume of water entering the net (sample volume filtered):
Water volume strained = A x t
Where:
A=circle area of plankton nets (π. r2)
t = lengthy of towing (m)

***Plankton Identification***

The identification of the plankton carried out in this study followed the instructions from the identification manual where the sample preparation of water on Sedgwick-Rafter was observed on the plankton found in determining the representative area. The plankton found matched with the identification book, and plankton's name was recorded.

***Calculation of Plankton Amount***

***Data Analysis for low Magnification Through the process as follows***

***Filling Sedgwick Rafter***

Place the deck-glass diagonally across from the S-R and insert the sample with a pipette. This is to avoid bubbles. Deck glass is rotated slowly until the S-R is full of sample water. The sample water filling should not exceed 1 mm because it can cause incorrect calculations.

***Calculating Groove***

The groove of the S-R is sample water volume arrangement in length 50 mm, height 1 mm and width 2 mm.
The sum of the calculated grooves is the accuracy and the value of the calculations of the organism per slot.

***The Calculation of Plankton on S=R as follows***

$$\text{Number of organisms} = \frac{C \times 1000\ mm^3}{LXDXWXS}$$

Where:

C = Number of organisms found
L = Groove length (S-R) mm
D = Height groove (S-R) mm
W = Width groove (S-R) mm
S = Number of grooves calculated

To calculate the abundance of plankton, then Michael (1994) was used as the guidance of data processing

$$n = \frac{(a \times 1000)}{l} \times c \text{ plankter/liter}$$

Where

N = Plankton abundance (number of plankter / liter )
A = Average number of plankter in 1 mL
c = mL plankton concentrated on filtered water
l = The volume of filtered water samples

***Calculation of Diversity Index***

To calculate the diversity, then used Shannon Index diversity (APHA. 1979) as a guidance of data processing.

$$H^1 = -\Sigma\left(\frac{ni}{N}\right) \ln\left(\frac{ni}{N}\right)$$

Where: S = The total number of species
ni = Number of individuals / species
N = Amount of overall individual

To calculate the uniformity, used Evennes' index (Odum. 1971) as guidance for data processing.

$$E = \frac{H^1}{H^1 \max}$$

Where:
S = Total amount of species
H max = Maximum diversity
E = Uniformity index

## RESULTS AND DISCUSSION

Species composition and Plankton Abundance
The results of the observation showed that the plankton dominating in Barru were two classes of phytoplankton,

Bacillariophyceae and Dinophyceace and two of Zooplankton, the Crustacean, and Cirripedia classes.

**Table 1** Percentage and Average Abundance of Plankton found in Barru waters.

| No | Class Plankton | Stations | | Average | | Percentage | |
|---|---|---|---|---|---|---|---|
| | | I | II | III | | Species | Aggregate |
| | *Phytoplankton* | | | | | | |
| 1 | Bacillariophyceae | 17 | 19 | 18 | 18 | 91,51 % | |
| 2 | Dinophyceae | 3 | 2 | - | 1,67 | 8,49 % | |
| | Quantity | 20 | 21 | 18 | 19,67 | 100 % | 64,13 % |
| | *Zooplankton* | | | | | | |
| 1 | Crustacea | 10 | - | - | 10 | 90,91 % | |
| 2 | Cirripedia | 1 | - | - | 1 | 9,09 % | |
| | Quantity | 11 | - | - | 11 | 100 % | 35,87 % |
| | Total | 31 | 21 | 19 | 30,67 | - | 100 % |

Note: 1 – 3 phytoplankton and 4 zooplankton

1. : Location of seaweed
2. : Location of floating net cage
3. : Location of pearl cultivation

The composition of phytoplankton and zooplankton in Barru waters tends to be dominated by abundant specific species (Table 1) shows that the most abundant species are the species of Bacillariophyceae class for phytoplankton, that is 91.52% and the species of the crustacean class for zooplankton, which is 90.91%. Wulandari (2009) stated that the abundance of phytoplankton in Indonesia is dominated by the diatom (Bacillariophyceae) class because they could grow faster than other types and also because of the ability to absorb nutrient elements from the environment.

Zooplankton was dominated by crustacean class (Table 1). Based on observations, species composition and abundance of phytoplankton and zooplankton in Barru waters were included in rich waters category due to the occurrence of various types of phytoplankton and zooplankton, which is abundant. They all founded in research location and highly varied between stations. A similar opinion was earlier given by (Baba and Pandit. 2014).

**Table 2** The composition plankton species found in Barru

| Class | Genus | Species | Average of abundance | | | |
|---|---|---|---|---|---|---|
| | | | I | II | III | IV |
| Bacillariophyceae | Bacteriastrum | *Bacteriastrum Delicatum* | - | - | 26,53 | - |
| | Bacteriastrum | *Bacteriastrum varlava* | 5,90 | 33,17 | 26,53 | - |
| | Biddulphia | *Biddulphia regia* | 11,79 | - | - | - |
| | Biddulphia | *Biddulphia mobiliensis* | - | - | 6,63 | - |
| | Biddulphia | *Biddulphia alternans* | 5,90 | - | - | - |
| | Biddulphia | *Biddulphia aurita* | - | 6,63 | - | - |
| | Chaetoceros | *Chaetoceros teres* | 11,79 | 26,54 | 39,81 | - |
| | Chaetoceros | *Chaetoceros decipiens* | - | 19,90 | 66,35 | - |
| | Chaetoceros | *Chaetoceros danicum* | 106,16 | 19,90 | 92,89 | - |
| | Chaetoceros | *Chaetoceros densum* | 5,90 | 19,90 | 199,04 | - |
| | Chaetoccina | *Chaetoccina poravianum* | - | 6,63 | - | - |
| | Cyclotella | *Cyclotella operculata* | - | 6,63 | 13,26 | - |
| | Coscinodiscus | *Coscinodiscus excenticus* | 11,79 | 13,26 | - | - |
| | Coscinodiscus | *Coscinodiscus granii* | - | - | 19,90 | - |
| | Eucampia | *Eucampia zoodiacus* | - | - | 13,26 | - |
| | Fragilaria | *Fragilaria oseania* | 11,79 | - | - | - |
| | Hyolotheca | *Hyolotheca undculata* | 23,59 | - | 26,53 | - |
| | Leptocylindricus | *Leptocylindricus donicus* | 23,59 | 26,53 | 6,63 | - |
| | Lauderia | *Leuderia borealis* | - | 6,63 | 6,63 | - |
| | Pleurosigma | *Pleurosigma Sp* | 11,79 | 19,90 | 46,44 | - |
| | Protocentrum | *Protocentrum balticum* | 11,79 | - | - | - |
| | Pinnate | *Pinnate diatom* | 5,90 | 19,90 | - | - |
| | Rhizosolenia | *Rhizosolenia stolterfothi* | 11,79 | 26,53 | 46,43 | - |
| | Rhizosolenia | *Rhizosolenia alata* | - | 6,63 | 19,90 | - |
| | Rhizosolenia | *Rhizosolenia Shrubsolei* | - | 13,26 | - | - |
| | Skletonema | *Skletonema costatum* | - | 6,63 | 6,63 | - |
| | Thalassionema | *Thalassionema nitzchiodies* | - | 13,26 | 13,26 | - |
| | Treubaria | *Treubaria triappendiculata* | 5,90 | 26,53 | 39,80 | - |
| | Thalassiosira | *Thalassiosira gravida* | 5,90 | - | - | - |
| Dinonophyceae | Ceratium | *Ceratium deflexum* | 5,90 | - | - | - |
| | Lysias | *Lysias clavier* | 11,79 | - | - | - |
| | Melosira | *Melosira monilifornas* | - | 19,90 | - | - |
| | Protocentrum | *Protocentrum balticum* | 11,79 | 5,90 | - | - |
| Crustacea | Calanos | *Calanos balanoides cypris* | - | - | - | 13,26 |
| | Calanus | *Calanus finmarchius* | - | - | - | 5,90 |
| | Cypris | *Cypris candida* | - | - | - | 5,90 |
| | Cyplos | *Cyplos rusus* | - | - | - | 5,90 |
| | Cyclopina | *Cyclopina longicornis* | - | - | - | 5,90 |
| | Enthamalus | *Enthamalus startus* | - | - | - | 5,90 |
| | Hyperia | *Hyperia galba* | - | -- | - | 5,90 |
| | Meganyctiphanes | *Meganyctiphanes norvegica* | - | - | - | 19,90 |
| | Synophia | *Synophia ulhamaurna* | - | - | - | 5,90 |
| | Verruca | *Verruca stroemia* | - | - | - | 5,90 |
| Cirripedia | **Elminius** | *Elminius modestus* | - | - | - | 5,90 |

Note: I – III phytoplankton and IV zooplankton

I. : Location of seaweed
II. : Location of floating net cage
III. : Location of pearl cultivation

***Diversity Index and Uniformity Index***

The diversity index (H) represents the species diversity of phytoplankton and zooplankton inhabiting a community, where the value of the difference is closely related to more or less the number of species present in the community.

Based on the condition of water quality, some expert suggested a close relationship with species diversity index based on the reality that environmental imbalances will affect the life of an organism living in waters. This is in the opinion of Odum (1971); that the higher the value of diversity index means more and more organisms inhabiting the area.

**Table 3** Value of diversity index

| Diversity Index IndeksKeanekargaman | Stations | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| | 2,48 | 2,82 | 2,42 | 2,26 |

Note: I – III phytoplankton and IV zooplankton
I. : Location of seaweed
II. : Location of floating net cage
III. : Location of pearl cultivation

Based on the observation, the diversity index value for phytoplankton is about 2.42 – 2.82 and the highest found at station II is 2.82. Diversity index for zooplankton which is only for one station is 2.26. It indicated that the species composition and abundance of plankton depends on the environmental conditions of the waters. this is in accordance with the results of the study M. A. El Gammal *et al*. (2017)

**Table 4** Value of uniformity index

| Uniformity Index | Stations Stasiun | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| | 0,842266 | 0,941339 | 0,821888 | 0,942493 |

Note: I- IIIphytoplankton and IV zooplankton
I. : Location of seaweed
II. : Location of floating net cage
III. : Location of pearl cultivation.

The value of uniformity index obtained for phytoplankton found was about 0.82 – 0.94 (Table 4) and highest value found in station II, that is 0.94. While for zooplankton in observation station, value index is of 0.94 which indicate that value tends to stabilize. The amount of the uniformity index can reach its maximum value if the spread of the number of individuals of each species is equals within a community.

**Table 5** Water quality data for phytoplankton and zooplankton

| Measurable parameters | Stations | | |
|---|---|---|---|
| | I | II | III |
| Salinity (‰) | 32 | 33 | 33 |
| Water temperature (° C) | 29 | 30 | 30 |
| Clarity (m) | 6,5 | 6,5 | 6,5 |
| Current velocity (m/s) | 0,08 | 0,07 | 0,06 |
| A potential of hydrogen on the water (pH) | 7,0 | 7,3 | 7,1 |
| Dissolved Oxygen (ppm) | 4,96 | 4,96 | 5,6 |
| Nitrate (ppm) | 1,64 | 2,59 | 2,59 |
| Phosphate (ppm) | 0,96 | 0,75 | 3,01 |
| Ammonia (ppm) | 0,034 | 0,036 | 0,037 |
| Gross Primary Productivity | | 9,6 | |
| Primary Productivity of Respiration | | 12,8 | |
| Nett Primary Productivity | | - 3,2 | |

Description
I. : Location of seaweed
II. : Location of floating net cage
III. : Location of pearl cultivation

Water environment conditions significantly affect the species composition and abundance of plankton, where the physical and chemical parameters on the waters significantly affect the physiology and characteristics of plankton. The abundance of phytoplankton obtained significant differences in the distribution of the both temporal and spatial, the correlation of the physical and chemical characteristics of the waters with an abundance of phytoplankton showed that East Season dominated by *Goniaulax* (Dinophyceae) and *Bellerochea* (Diatom) which is influenced by phosphate, silica, ammonia, turbidity and pH. Transition Season I and West Season dominated by *Triceratium, Skeletonema, Bacillaria, Planktoniella, Ditylum, Diploneis* and *Prorocentrum* are affected by temperature, salinity, nitrite, ration of dissolved inorganic nitrogen to dissolved silicon, Secchi depth and euphotic zone (Pello *et al*. 2014).

One of the most influential physical properties for plankton life is salinity, where marine organism mainly plankton have different abilities to adapt to the salinity range, and this shows that salinity is the determining factor of plankton distribution. The combination of factors influences the zooplankton distribution and abundance in an estuary. Among the various factors examined, an abrupt change in salinity caused by rainfall can be considered the most critical water quality parameter which affects zooplankton abundance as reported previously by Watanabe *et al*. (1983), Rajkumar *et al*. (2004), Thirunavukkarasu *et al*. (2013); Nassar *et al*. 2014.
Salinity measured in the observation area was $32^{o}/_{oo}$ on station I and $33^{o}/_{oo}$ on station II and III. While on station IV which is the observation station of zooplankton, salinity obtained as much as $31^{o}/_{oo}$. The difference of salinity data this time is due to respiration and runoff from the mainland (Nybakken, 1988).

Other marine environmental factors measured this practice was temperature, where the temperture measured ranges from 27 – $30^{o}$C, where the water temperature affects the physical, chemical and biological aspects of the aquatic environment. These temperature values are suitable for the life and development of planktons where right temperatures for growth and development of plankton range from 20 – $30^{o}$C (Gossari. 2002). The increase of the heat causes the metabolism of the air organism increases. This lead to the decrease of dissolved gas in the water.

Aquatic clarity is one of the decisive factors for plankton abundance. The clarity value observed at study site was up to 6.5 m depth based on Secchi disc observation, however not measured based on the actual extent of the waters. Based on the fact that high clarity affects the productivity and distribution of plankton and another marine organism.

The results of the measurements on environmental parameters (N, P, NH3) obtained significant values for ecological parameters on the abundance of phytoplankton and zooplankton, which among others considerable amounts are nitrates, phosphates, and ammonia, where the higher the content of nitrate and phosphate in a waters the more influence on the growth rate of plankton. The primary source of phosphate and nitrate comes from organic waste, which is the supply from the mainland.

The degree of acidity (pH) is a theory used to explain the characteristic of the compounds in the water. The aspect of the mixture in water can be either acid or alkali. Acid is a

compound that produces hydrogen ions when dissolved in the water, and salt is a compound that produces hydroxyl ions in the water. Based on the observation's result, the pH ranged from 7.0 to 7.3, and it means that the waters are suitable for plankton growth because according to Gossari (2002), who stated that, the productive waters are one that has pH 6.5 – 7.5.

The dissolved oxygen (DO) in the water very indispensable for any aquatic organism. The result of the measurement of dissolved oxygen (DO) at the observation area is 4,96 ppm and 5.6 ppm on the stations. That range strongly supports the life of plankton, and this is by the opinion of Gossari (2002) that oxygen levels for plankton growth are not less than 4 ppm. From this value, it can be said that the waters around Barru are still good for the growth of plankton.

Ammonia content is one of an essential element for the growth of organisms and is one of the main aspects of protein forming. The value of ammonia content at the phytoplankton station was measured 0.034 ppm on a station I and station II and III each got a value of 0.036 and 0.037 ppm. Whereas on zooplankton observation station got the value of NH3 equal to 0.039 ppm. A substantial amount of ammonia is caused by the discharge of domestic waste from the mainland and supply from the river. This is in accordance with the results of the study Hefni Effendi (2016) that phytoplankton diversity and abundance in delta front was higher than that in delta plain. Human activities and physical process likely influenced diversity and abundance of phytoplankton in Delta Mahakam.
The high value of ammonia content that enters the waters affect the growth of plankton. (Hendersen. 1978) states that phosphorus content > 0.010 mgP / l and nitrogen > 0.300 mgN/ l in water. both good or one of them will stimulates the growth of phytoplankton and multiply rapidly, resulting in blooming.

Other substances measured are nitrate and phosphate. A phytoplankton concentration of nitrate found was appear respectively 1.64 ppm on a station I and 2.59 ppm on station II and 2.59 ppm on station III. Also, the phosphate content obtained respectively was 0.96 ppm; 0.75 ppm and 3.01 ppm. Whereas for zooplankton, acquired data content of nitrate and phosphate apiece 1.59 ppm and 3.51 ppm. A substantial amount of phosphate and nitrate contents possibly due to the presence of domestic waste discharges around the waters.
Based on environmental parameters measured as a whole during the observation, it can be said that Barru waters conditions still feasible for the growth and development of plankton.

## CONCLUSION

1. The composition of the phytoplankton species found in Barru waters was phytoplankton from the diatom class (Bacillariophyceae) consisting of 29 species and Dinophyceace composing of 4 species. While for zooplankton, it is dominated by crustacean class consisting of 10 species, and other species are from class Cirripedia which only found one species.
2. Aquatic chemical and physical factors supported phytoplankton and zooplankton to live and breed in these waters.
3. The values of uniformity index and diversity index tend to be stable at all observations stations.

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## References

APHA(American Public Health Association). 1979. *Standard methods for the examination of water and wastewater*. 17thd. APHA, AWWA (American Waste Water Association) and WPCF (Water Pollution Control Federation). Baltimore, Maryland: Poet City Press; 1979.

Aryawati R, Bengen D. G., Prartono T. and Zulkifli H. 2014. Abundance of Phytoplankton in The Coastal Waters of South Sumatera. Ilmu Kelautan March Vol 22(1):31-39. 2014. ISSN 0853-7291

Baba AI, Pandit AK (2014) Species Composition, Diversity and Population Dynamics of Phytoplankton at Saderkot in Wular Lake, Kashmir. J EcosysEcograph 4:142. doi: 10.4172/2157-7625.1000142

Bahaar, S.W.N. and G.A. Bhat, 2011. Aquatic biodiversity in the paddy fields of Kashmir valley (J and K) India. Asian J. Agric. Res., 5: 269-276.

Barnes R.S.K. and K.H. Mann. 1971. Fundamentals of Aquatic Ecosystems. Blackwell Scientific Publications.Oxford London Edinburgh Boston Melbourne.229 p.

Cardosoa S. J, Rolanda F, Loverde S.M - Oliveira, Vera Lúcia de Moraes Huszar. Phytoplankton abundance, biomass, and diversity within and between Pantanal wetland habitats. Limnologica 42 (2012) 235– 241

Choiru A, Sari S.H.J, Iranawati F. 2015. Phytoplankton Harmfull Algae Bloom (HAB) Identification during Tide Period in Brondong Coastal Waters, Lamongan, East Java. Torani (Jurnal Ilmu Kelautan dan Perikanan) Vol.25 (2) Agustus 2015: 58-66.

D.J. Mackey, J. Blanchot, H.W. Higgins, J. Neveux. 2002. Phytoplankton abundances and community structure in the equatorial Pacific. Deep-Sea Research II 49 (2002) 2561–2582.

Davis CC. 1955. *The marine and fresh water plankton*. USA. Michigan State University Press.

Dong, Ji., ZhouW., Song L and Li G. 2015. Responses of phytoplankton functional groups to simulated winter warming. Ann. Limnol. - Int. J. Lim. 51 : 199-210.

Fachrul, M. F. 2007. Bioecological Sampling Method Jakarta: Bumi Askara.*in Indonesia.*

Farhadian, O. &Pouladi, M. (2014) Seasonal Changes in the abundance and biomass of zooplankton from shallow mudflat river-estuarine system in Persian Gulf . Braz. J. Aquat. Sci. Technol. 18(2):19-29. eISSN 1983-9057. DOI: 10.14210/bjast.v18n2.p19-29.

Fathi, A.A., M.A. Al-Fredan and A.M. Youssef, 2009. Water quality and phytoplankton communities in Lake Al-Asfar, Al-Hassa, Saudi Arabia. Res., J. Environ. Sci., 3: 504-513.

Gosari, B. 2002. Type Composition Dangerous phytoplankton Around the Soekarno-Hatta Port. Skripsi. Universitas Hasanuddin. Makasar. In Indonesia.

Hendersen B. and H.R. Markland"Decaying Lakes-The Origins and Control of Cultural Eutrofication", John&

Willey Sons Ltd. New York. Brisbane, Toronto, Singapura, 1987.

Luyiga, S and Kiwanuka S. 2003. Plankton composition, distribution, and significance in an integrated tropical pilot constructed treatment wetland in Uganda. Water SciTechnol;48(5):241-8.

Michael, P.1994. Ecological Methods. For Field Investigations and Laboratories. UI press, Jakarta.*in Indonesia*.

Nassar M. Z, Mohamed H. R, Khiray H. M, Rashedy S. H. 2014. Seasonal fluctuations of phytoplankton community and physicochemical parameters of the northwestern part of the Red Sea, Egypt. Egyptian Journal of Aquatic Research, 40, 395–403

Nontji, A. 2008.Plankton. LIPI press, IKAPI members. Jakarta. *in Indonesia*.

Nowrouzi, S. and H. Valavi, 2011. Effects of environmental factors on phytoplankton abundance and diversity in after lake. J. Fish. Aquat. Sci., 6: 130-140.

Nybakken, J. W. 1988. Marine Biology:An Ecological Approach. Gramedia, Jakarta. In Indonesia.

Odum EP. 1971. *Fundamentals of ecology*. *3rd edition*. London: W.B Saunders Co.

Pello, F. S., E. M. Adiwilaga, N. V. Huliselan, A. Damar. 2014. Seasonal Variation of the Composition and Density of Phytoplankton in Inner Ambon Bay. Aquatic Science and Technology .ISSN 2168-9148.2014, Vol. 2, No. 1.

Periyanayagi, R., V. Sasikala, R. Venkatesan, R. Karthikayen and T. Balasubramanian, 2007. Phytoplankton about pollution in upper estuary Southeast coast of India. Res. J. Environ. Toxicol., 1: 153-157

Prescott, G. W. 1970. How to Know Freshwater Algae. Dubuque. Lowa.WM. C.Brown Company Publishers.

Rajkumar M, Santhanam P, Perumal P (2004) Laboratory culture of calanoid copepod, Acartia clause Giesbrecht. Appl Fish Aqua 4: 5-8.

Ramakrishna, S. (2014).Zooplankton seasonal abundance about physicochemical feature in Yelahanka Lake, Bangalore, India. Global J. Res. Anal., 3, 218-219.

Romimohtarto K., 1999. *Marine Biology*.Science about Marine Biota .Oceanology Research and Development Center– LIPI, Jakarta.In Indonesia.

S. M. Gharib, Z. M. El-Sherif, A. M. Abdel-Halim, A. A. Radwan. 2011. Phytoplankton and environmental variables as a water quality indicator or the beaches at Matrouh, south-eastern Mediterranean Sea, Egypt: an assessment. Oceanologia, 53 (3), 2011. pp. 819–836. doi:10.5697/oc.53-3.819

Sachlan, M. 1982. Planktonology. Faculty of Animal Husbandry and Fisheries.Universitas Diponegoro. Semarang. *In Indonesia*.

Sahami, F.M., Baruadi A. S. R. Baruadi, Hamzah S. N. 2017. Phytoplankton abundance as a preliminary study on pearl oyster potential culture development in the North Gorontalo water, Indonesia AACL Bioflux, 2017, Volume 10, Issue 6.

*Setiabudi*, *G. I.*, *Bengen*, *D. G.*, *Effendi*, *H.*, & Radjasa, *O. K.* (2016). The Community Structure of Phytoplankton in Seagrass Ecosystem and its Relationship with Environmental Characterstics. *Biosaintifika: Journal of Biology& Biology Education*, 8(3), 257-269.

Sidabutar T, Bengen D. G, Wouthuyzen S, Partono T. 2016. The abundance of phytoplankton and its relationship to the N/P ratio in Jakarta Bay, Indonesia. Biodiversitas 17: 673-678.

Siva R. Sankar and G. Padmavati, 2012. Species Composition, Abundance, and Distribution of Phytoplankton in the Harbour Areas and Coastal Waters of Port Blair, South Andaman. *International Journal of Oceanography and Marine Ecological System, 1: 76-83.*

Thirunavukkarasu K, Soundarapandian P, Varadharajan D, Gunalan B (2013)Zooplankton Composition and Community Structure of Kottakudi and Nari Backwaters, South East of Tamil Nadu. J Environ Anal Toxicol 4: 200. doi: 10.4172/2161-0525.1000200

Thoha. 2007. Plankton abundance in Gilimanuk Bay of National Park Ecosystem, West Bali. *Makara, Sains, Vol. 11, No. 1, April 2007: 44-48*

Watanabe T, Kitajima C, Fujita S (1983) Nutritional values of live organisms used in Japan for mass propagation of fish-A review. Aquacul 34: 115-143.

Wulandari, D. 2009. Attachment Between Phytoplankton Abundance with Chemical Physics Parameters At the Brantas River Estuary (Porong) East Java. Skripsi. Department of Water Resources Management.
faculty of Fisheries and Marine Science. IPB. *In Indonesia*.

Effendia H, Kawaroeb M, Lestaria D. F, Mursalina, Permadi T. Distribution of phytoplankton diversity and abundance in Mahakam Delta, East Kalimantan. Procedia Environmental Sciences 33 ( 2016 ) 496 – 504.

El Gammal, M. A. M., Nageeb M, Al-Sabeb S. Phytoplankton abundance in relation to the quality of the coastal water – Arabian Gulf, Saudi Arabia. The Egyptian Journal of Aquatic Research. Volume 43, Issue 4, December 2017, Pages 275-282

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