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Fertility Level Waters Based on Abundance Plankton, Nutrients and Water Quality in The Water Merauke Sea Papua Province

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ABSTRAK

Kelimpahan plankton memegang peranan yang sangat penting dalam menentukan kesuburan perairan. Plankton berperan sebagai produsen primer di perairan. Kelimpahan plankton di perairan umumnya berkaitan dengan kandungan unsur hara yang ada di dalamnya. Penelitian ini bertujuan untuk menganalisis tingkat kesuburan Perairan Laut Merauke berdasarkan kelimpahan plankton dan kondisi kimia fisik di perairan Laut Merauke. Sampel yang digunakan merupakan sampel air yang diambil dari 25 stasiun. Hasil penelitian menunjukkan kelimpahan plankton di perairan Laut Merauke tergolong tinggi. Kelimpahan fitoplankton bervariasi berkisar antara 4.047.547-1.053.078 ind/m 3/stasiun. Kelompok yang mendominasi adalah Baciliophyceae, indeks keanekaragaman (H') rendah <1, keseragaman hampir 0, indeks dominan rendah, sedangkan zooplankton juga tergolong tinggi dengan kisaran kelemahan antara 5.500 – 460,281 ind/m3/stasiun. Berdasarkan kondisi fisik dan kimia air laut, suhu di Perairan Laut Merauke berada di kelas homogen dengan kisaran 25,95ºC–27,58ºC, kecerahan rendah 0-2 m, kekeruhan tinggi 2,89-730 NTU, pH termasuk homogen berkisar antara 7,06-8,11, DO sangat tinggi antara 8,00-9,55 mg/L, dan nutrisi fosfat yang tinggi.

Kata kunci : *Plankton, Kualitas Air Laut, Nutrisi, Merauke*

ABSTRACT

The abundance of plankton holds very important role in determine fertility waters as primary producers in water. The abundance of plankton in a waters generally related with content nutrients This research aims to analyze fertility level in Sea Merauke based on abundance of plankton and physique chemistry conditions in Merauke Sea. Water sample is drawn at 25 station. Results show abundance plankton in Merauke Sea is high. Abundance phytoplankton varied range between 4,047,547-1,053,078 ind/m 3/station. Dominating group is Bacilliophyceae, index diversity (H ') low <1, uniformity almost 0, index dominant low, while zooplankton is also classified as tall with weakness range between 5,500 – 460,281 ind /m3/ station. Based on the physical and chemical conditions of sea water, the temperature in the Merauke Sea waters is in a homogeneous class with a range of 25.95 0 – 27.58 0 C, brightness low 0 – 2 m, turbidity high 2.89 – 730 NTU, pH between 7.06 – 8.11, very high DO between 8.00 – 9.55 mg/L nutrien fosfat is high.

Keywords: *Plankton, Seawater Quality, Nutrients, Merauke*

INTRODUCTION

Marauke waters are a fish barn for the Papua region. The high potential for fish sources indicates that Merauke waters are fertile waters (Ali & Wekke, 2021). The high fertility of the waters

is due to the input of nutrients from land via rivers as well as nutrients from the upwelling process during the east monsoon.

Water quality assurance data is needed as supporting data that can provide information about water fertility (Wibawa & Luthfi, 2017), including levels of nutritional compounds that support the life of marine organisms. The abundance of plankton plays a very important role in determining the fertility of waters. Plankton as the main producer in the waters depends on the presence of nutrients and the intensity of sunlight. The abundance of Plankton will be higher if the nutrients and intensity of sunlight are high. Until now there has been no research discussing the abundance of plankton and nutrient content in the Merauke Sea Waters (Dharmaji *et al*., 2019), this makes this research necessary. This study aims to obtain data on the results of in situ water quality measurements in these waters. in the form of data on temperature, salinity, turbidity, pH, DO, nutrients (N and P), plankton in the waters of Merauke Regency. Therefore this research is useful to obtain information about the condition of water fertility which is in harmony with the abundance of plankton. The abundance of Plankton can be seen based on the season and can be used to predict the potential of fish resources in the waters of Merauke Regency.

MATERIALS AND METHODS

Temperature, Turbidity, Brightness, DO, pH and Nutrients

Data collection is done directly by taking samples in the field. Sampling used equipment including a thermometer to measure temperature, dissolved oxygen (DO) meters (measuring dissolved oxygen levels), pH meters (measuring pH/acidity), turbidity meters, and Secchi disks. Sampling was carried out at 25 points in Merauke waters which was carried out in September 2015 (Armiani & Harisanti, 2021).

Plankton

Plankton sampling was carried out using a plankton net with a water filter method. The water required for the phytoplankton sample is 70.65 liters and 141.3 liters for the zooplankton sample. The samples were then identified using a microscope to obtain data on the type, number of species, and abundance of plankton. Analysis of plankton data (phytoplankton and zooplankton) was then carried out to find out ecological indicators which include diversity index, uniformity index, and dominance index which can be calculated from data on the abundance of each species (Schartau *et al.*, 2022).

Abundance Phytoplankton

The abundance of phytoplankton is the number of cells per unit volume. The number of cell phytoplankton is calculated using the following formula (Rice *et al*., 2012).

$$K = \frac{1}{A} x \frac{B}{C} x \frac{V}{v} x n$$

K = Abundance phytoplankton (cells /m), B = Total area/ area receptacle Sedgwick-Rafter Counting Cell (mm2), A = Volume of filtered water sample (70.65 L), C = Area of observation (mm 2), V = Volume of filtered water (225 mL), v = Volume of concentrate in Sedgwick-Rafter Counting Cell (mL), and n = Amount observed phytoplankton.

Zooplankton Abundance

The abundance of zooplankton is total individuals per unit volume. Abundance the type of zooplankton is calculated based on equality according to following :

$$N = \frac{Oi}{Op} x \frac{Vr}{Vo} x \frac{1}{Vs} x \frac{n}{p}$$

Where, N = Abundance zooplankton (eng /m^3), Oi = area of glass cover, preparation (mm^2), Op = Area one field view (mm^2), Vr = Volume of filtered water (225 ml), Vo = Volume of observed water (ml), Vs = Volume of filtered water (141.3 L), n = Number of zooplankton in all field view, and p = Total field look at that observed.

Index Diversity

Index diversity used is index Shannon-Wiener diversity, which is formulated as following :

$$N = \sum \frac{ni}{N} \ln \frac{ni}{N}$$

Where, H' = Index diversity, ni = Total individual taxa i th, and N = Total number of individuals.

Index Uniformity

Index uniformity describe composition individual each available types in something community. Index uniformity determined by using formula as following (Odum & Barrett, 1971):

$$E = \frac{H'}{LnS}$$

Where, E = Index uniformity, H' = index diversity, S = number taxa (species), and Ln S = H' maximum.

Index uniformity (E) ranges between 0 - 1. E value close to 0 indicates that deployment total individual each species no the same and there trend that community no stable. Otherwise if the value of E is close to 1 means deployment organism even and stable community more high (Odum & Barrett, 1971).

Index Dominance

Index dominance describe composition abundance each available types in a dominant community. This condition causes a community to be unstable and vulnerable to changes in the ecosystem. Index dominance is determined using the following formula (Odum & Barrett, 1971) :

$$E = \sum \left[\frac{ni}{N} \right]^2$$

Where, D = index Simpson dominance, ni = sum individual to i, and N = total number of individuals.

Index dominance range between 0 -1, where :

D = 0 : No species dominates over another or the community structure is stable.

D = 1 : There are species that dominate other species, or the community structure is unstable, due to ecological stress.

RESULTS AND DISCUSSION

Physical, Chemical, and Biological Conditions of Waters *Temperature*

Temperature measurements were carried out simultaneously with measurements of other water quality parameters such as turbidity, brightness, salinity, pH and dissolved oxygen content. Temperature parameters were measured using a CTD (Conductivity Temperature Depth) device at 25 CTD station points from the surface to the bottom (Crescentini *et al.,* 2012). Temperature measurements are carried out following the surface layer pattern with a higher temperature than

the higher layer. The results of CTD temperature measurements in September 2015 in Merauke Regency are presented in Table 2.

Table 1. Results temperature CTD measurement September 2015 in Merauke Regency

Station	Temperature [°C]			Depth [m]
	Minimum	Maximum	Average	
St 1	26,074	26,268	26.204	5.1
St 2	25.95	26,102	26.034	6.7
St 3	26,304	26,389	26,337	8.5
St 4	26,384	26.401	26,393	4.5
St 5	26,448	26,736	26,550	5.8
St 6	26.15	26.26	26,194	9
St 7	26.511	26,529	26.516	5
St 8	26.641	26,681	26,670	7.9
St 9	26.62	26,857	26,638	19.4
St 10	26,597	26.633	26.604	20.4
St 11	27,506	27,581	27,536	4.9
St 12	26,698	26,743	26.714	11.4
St 13	26.532	26.641	26,566	15.3
St 14	27.348	27.374	27.354	1.3
St 15	26,717	26.868	26,798	5.7
St 16	26,822	26,909	26,863	6.1
St 17	27,173	27,202	27,185	4.5
St 18	26.95	27.096	27.007	6.1
St 19	26,849	26,889	26,880	5.2
St 20	26,693	26.72	26,717	7.3
St 21	26.54	26,563	26,557	4.4
St 22	26.49	26,507	26,499	3.1
St 23	26,234	26,303	26,273	4.5
St 24	26,658	26,962	26,798	5.6
St 25	26,617	27.166	26,778	6.9

The transverse temperature profile is presented in Figure 1, where Transect 1 is a measurement along the waters of Merauke in the south, Transect 2 is a measurement along the waters of Merauke in the north. Water temperature is classified as homogeneous with temperatures between 25.95 °C to 27.581 °C. Variations in water temperature are higher at shallow depths than at deep depths. The results show that the surface temperature tends to fluctuate between stations due to differences in measurement time.

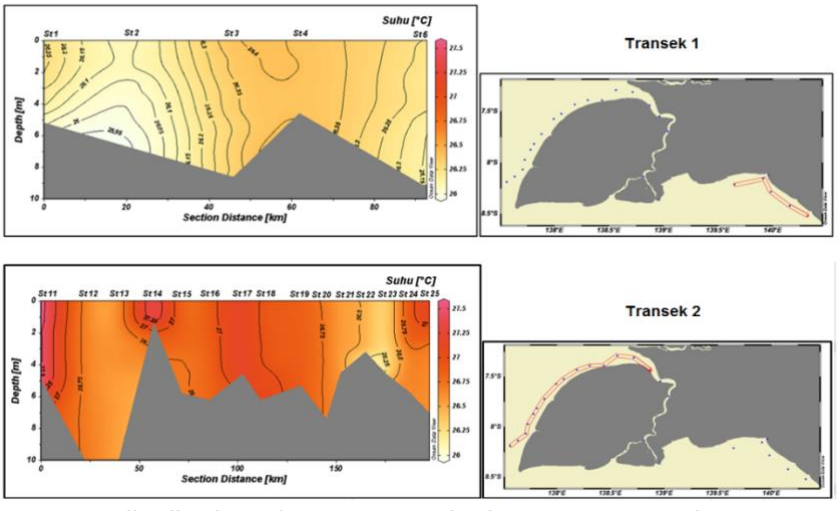

Figure 1. Transverse distribution of temperature in the waters Merauke Regency in September 2015**.**

The measurement results show that the waters bordering the southern Merauke Waters found indications of a meeting of water masses that occur throughout the year which are expected to originate from the water masses on the north coast of Australia and the south coast of the waters of the South Coast of Papua. There is no potential for upwelling in the waters south of Merauke but these waters have a high fertility rate throughout the year. This condition can be caused by the process of mixing the water masses vertically in these waters due to the varying bathymetric profiles, so that nutrients from the mainland are not deposited on the bottom of the water and are stirred along the water column (Pane *et al*., 2020). The process of mixing the water masses is strengthened by the presence of very large tides so that at low tide it catches the basic waters of nutrients far inland and at low tide it brings water masses that contain high nutrients towards the open sea.

Turbidity, Brightness, DO and pH

The physical and chemical parameters of the waters at the study site can be seen in Figure 2. It can be seen that the brightness of the waters tends to be low, ranging from 0 to 2 m. This is because the waters of Merauke Beach are generally shallow and have a mud substrate (Jonnalagadda & Mhere, 2001). The results of water turbidity measurements show high values, ranging from 2.89 - 730 NTU. This is because the intensity of the wind that is high enough can make the mud at the bottom of the waters easily swayed and make the waters look cloudy (Aryawati & Thoha, 2011).

The acidity level is within the normal range, namely pH 7.06 – 8.11. This pH condition is safe and will not cause environmental pressure for the biota that live in these waters. Mostly low pH values of 7.06 are found around river mouths. The DO value is relatively high, around 8.00 - 9.55 mg/L which is probably caused by turbulence or quite intensive stirring.

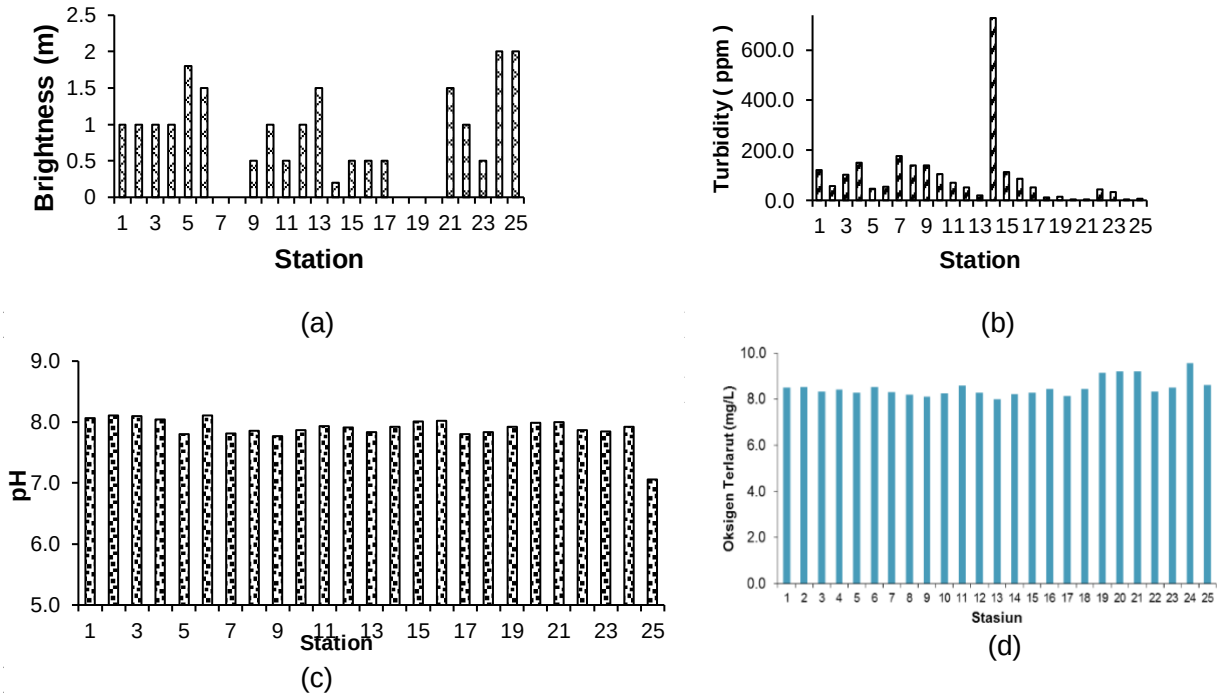

Figure 2. Parameters of water quality in the waters of Merauke Regency, including (a) Brightness; (b) Turbidity; (c) pH; and (d) Dissolved Oxygen in August 2015

Nutrient

Nitrates include compounds needed as nutrients for marine organisms, especially phytoplankton. Phytoplankton can produce marine primary productivity as a determinant of the level of water fertility and support the continuity of other marine life (Kirchman & Wheeler, 1998). Based on the measurement results, the content of Nitrate and Phosphate nutrients in the coastal waters of Merauke Regency is high, especially when compared to the Seawater Quality Standards for Marine Biota, Decree of the Minister of Environment No. 51 of 2004. The highest concentration of nitrate is at Station 5 while the highest concentration of phosphate is found at Station 19 which is located close to the mainland, where there is a dense mangrove ecosystem.

(3).

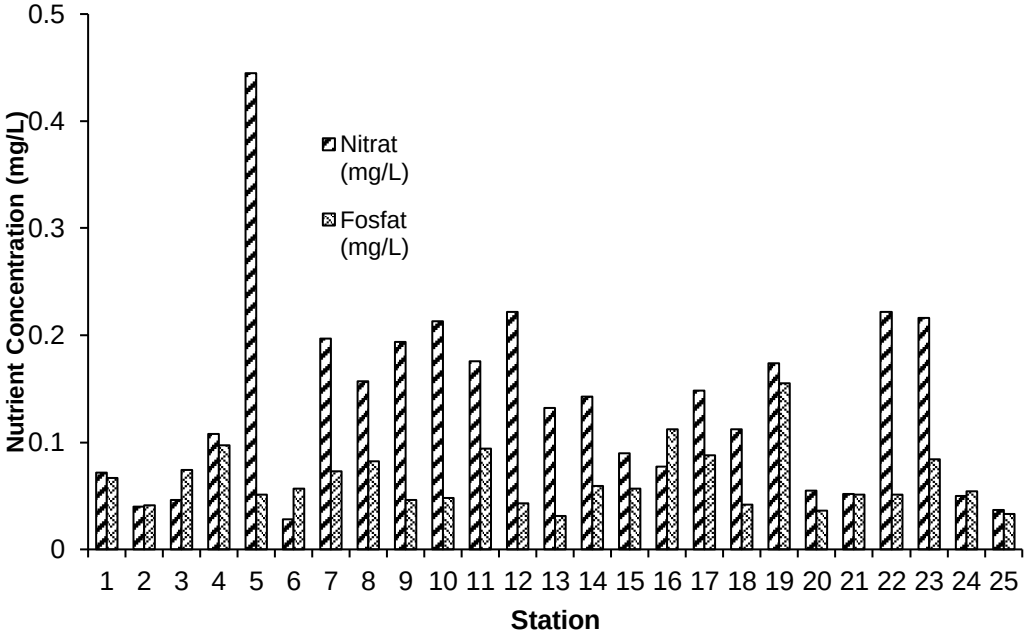

Figure 3. Concentration of nutrients (nitrate and phosphate) in the waters of Merauke Regency in September 2015

Plankton

Phytoplankton

According to observations, the abundance of phytoplankton in Merauke waters is high. The number of phytoplankton at the 25 observation stations ranged from 4,074,547-1,053,078,559 cells/m^3 (Boero *et al.,* 2008). Community phytoplankton dominated by group Bacillariophyceae, where several genera in abundance enough tall as Coscinodiscus sp., Thalassionema sp., Chaetoceros sp., and Lauderia sp. Abundance Lauderia sp. very high, reaching 717,905,166 cells /m 3, was found at Station 21. This genus is food the main fish tembang (*Sardinella fimbriata*) (Simarmata *et al.*, 2014).

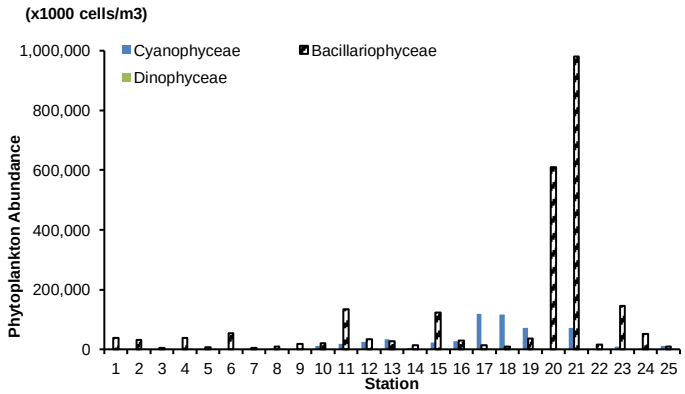

Figure Error! No text of specified style in document.**.** The results of the abundance of phytoplankton at the observation station in the waters Merauke Regency.

In several observation stations, abundant phytoplankton was found, so that the index of ecological signs of phytoplankton varied at each station (Figure 5). The diversity index (H') which at several stations has a value of <1, followed by the uniformity index (E) which is close to 0 and the dominance index (D) which is close to 1, indicating the presence of many dominant genera (Ulfah *et al*., 2019). At station 18 which has the lowest H' and E index and the highest D index. The data shows the dominance of the genus Trichodesmium sp. from the Cyanophyceae group to other phytoplankton.

Zooplankton

Zooplankton was also collected from 25 stations using the water sampling method. There are 7-17 zooplankton taxa found at the study site, the Crustaceae group, such as stadia Nauplius and Calanus sp. found to be dominant at all stations (Ballali S, Hoseini SA, Ghorbani R and Khordi, 2013). Nauplius is one of the stages of a crustacean that lives in the form of a larva, has limbs that are not segmented, and its genus cannot be ascertained, while Calanus sp. is a member of the Crustacea group of the Copepods subclass with the Calanidae family. The highest abundance of crustacean larvae was at station 4 which was 329,912 ind/m^3 (Figure 5).

The abundance of zooplankton at the survey site was high, between 5,500 ind/m^3 to 460,281 in/m^3, the highest limit was at station 5, while the lowest zooplankton crate was at station 25 (Carrillo-Baltodano & Morales-Ramírez, 2016). The abundance of zooplankton is an indicator of winning fish, because zooplankton is the main food source for fish.

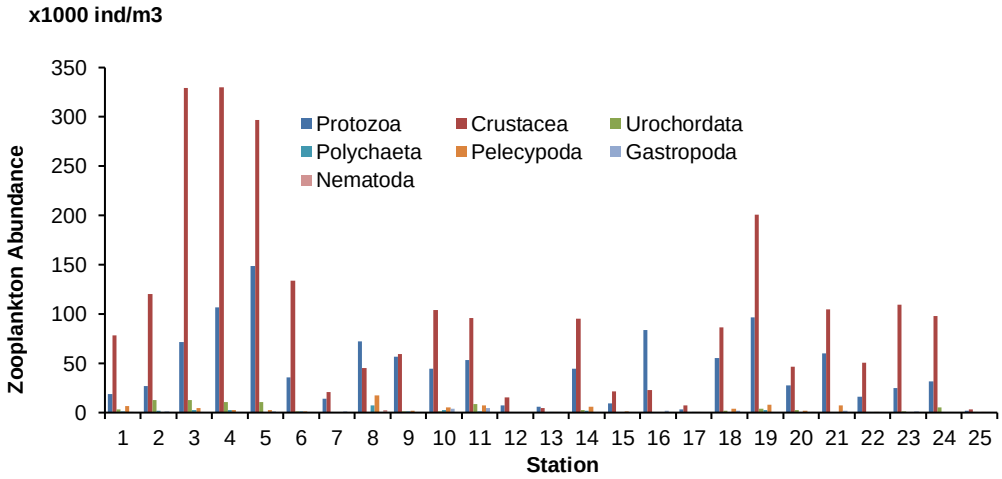

Figure 5. Results of zooplankton abundance at each observation station.

The Shannon-Wiener Diversity Index as a whole shows the expanse of zooplankton at all stations in the medium range, namely 1<H<3 (Table 3). Meanwhile, the distribution of individuals at each station was almost uniform, with a uniformity index sign (E) close to 1. The same thing was shown with a dominance trend index close to 0, this value indicated that there was no dominant taxa in the waters research location. Based on the index mark III, the water conditions at the study site can be classified as moderate and not experiencing extreme environmental pressure (Thakur *et al*., 2013).

Table 3. Index Zooplankton Ecology In Each Station Observation On The Water Merauke Regency In September 2015.

Station	Index Diversity (H')	Index Uniformity (E)	Index Dominance (D)
1	2.161	0.779	0.150
2	1,881	0.713	0.201
3	2,053	0.725	0.184
4	1.999	0.779	0.163

Station	Index Diversity (H')	Index Uniformity (E)	Index Dominance (D)
5	2018	0.787	0.159
6	2,031	0.769	0.173
7	2,086	0.813	0.156
8	2,044	0.888	0.152
9	1,777	0.772	0.207
10	2004	0.807	0.168
11	2.022	0.789	0.169
12	1.483	0.713	0.284
13	1,570	0.715	0.278
14	1955	0.762	0.193
15	1,461	0.751	0.300
16	1,688	0.733	0.248
17	1,824	0.877	0.195
18	1.909	0.705	0.227
19	2007	0.808	0.176
20	1,883	0.785	0.207
21	1,919	0.748	0.196
22	1,819	0.790	0.198
23	1,764	0.766	0.206
24	1,795	0.780	0.215
25	1998	0.833	0.165
Min	**1,461**	**0.705**	**0.150**
Max	**2.161**	**0.888**	**0.300**

Based on the results of the guess area fishing is carried out based on oceanographic parameter data such as sea surface temperature, chlorophyll concentration and ATML. The results of research around Arafura waters including Merauke show that there is a significant relationship between the abundance of phytoplankton and fish catches (Kurniawan *et al*., 2021). From the existing data, it can be predicted that throughout the year the abundance of fish resources around the coast is quite high as is the abundance of cantoons (Flower *et al.*, 2013). This is closely related to the distribution and abundance of plankton as primary producers that can be utilized for the level of fertility of marine waters.

CONCLUSIONS

The results showed that the abundance of plankton in the waters of the Merauke Sea was high. The abundance of phytoplankton varied from 4,047,547-1,053,078 ind/m3/station. The dominating group is the Bacilliophyceae, the diversity index (H') is low <1, the uniformity is almost 0, the dominance index is low. The abundance of zooplankton is high with a range between 5,500-460,281 ind/m3/station. The physical and chemical conditions of seawater such as temperature are homogeneous, namely between 25.95º-27.58ºC, low brightness 0-2 m, high turbidity 2.89-730 NTU, homogeneous pH between 7.06-8.11, DO is very high between 8.00-9.55 mg/L, while the nutrients are in the form of phosphate is high. Based on these parameters, the waters of the Merauke Sea can be categorized as fertile waters.

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