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Analysis of Plankton Diversity and Abundance in the Wiringtasi River, Barru Regency, South Sulawesi, Indonesia

Patang

Department of Agricultural Technology, Universitas Negeri Makassar, Kota Makassar, Indonesia

ABSTRACT: The research aims to determine the level of plankton abundance and diversity in the Wiringtasi River, Barru Regency, South Sulawesi, Indonesia. The research was conducted from August to September 2024 at three research locations, namely location 1, namely the river location adjacent to rice fields; location 2, namely the river area adjacent to ponds and beaches; and location 3, namely the location around the mouth of the Wiringtasi River, Barru Regency. Water samples obtained at the research location were taken to the laboratory for analysis. The plankton samples obtained were calculated for abundance, species diversity, species uniformity, and dominance index. The data obtained was then processed and analyzed using descriptive analysis. The results showed that the highest abundance of plankton was in the *Melosira* sp. type plankton (location 1) and *Navicula* sp. type plankton (locations 2 and 3). The level of diversity and uniformity of plankton at the research location was highest at location 1, namely the location adjacent to the rice fields. The highest level of plankton dominance is found in the *Melosira* sp type plankton (location 1), while in locations 2 and 3, the plankton is dominated by the *Navicula* sp type.

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Corresponding Author: Patang

KEYWORDS: Abundance, Uniformity, plankton, Wiringtasi, Barru.

INTRODUCTION

Plankton are organisms that live floating in waters, and their swimming ability is very weak, so their movements are greatly influenced by the presence of water currents around them (Silaban et al., 2022). Plankton in aquatic ecosystems has a very important role, namely as the basis of life. Plankton are microscopic organisms that have a very important role, namely as the basis of life, especially in pelagic aquatic life (Novrilianty et al., 2022). Plankton is also a very diverse aquatic organism in both fresh, brackish, and marine waters. Plankton is an aquatic organism that plays a very important role in an aquatic ecosystem in determining the status of waters by knowing the abundance and types found in those waters (Rumondang, 2017).

Plankton is classified into two types, namely, phytoplankton and zooplankton (Nontji, 2008). Phytoplankton is autotrophic plant plankton, which means it has the ability to photosynthesize and can convert inorganic compounds into organic compounds (Rofiki et al., 2019). Phytoplankton are primary producers that make the largest contribution to aquatic ecosystems (Rofiki et al., 2019). Meanwhile, zooplankton have an important role in the food chain, namely as primary consumers in aquatic ecosystems (Rumondang, 2017). Plankton can be found both in sea waters and in public waters such as lakes, swamps, or rivers.

The river, which is widely used by the community, is also a place for the development of all organisms in the river, one of which is living organisms, namely plankton. Plankton, with its characteristics of floating and moving with the current, is one of the biological resources that has an important role in aquatic ecosystems, especially coastal aquatic ecosystems (Rumondang and Paujiah, 2019). Nybakken (1982) states that at river estuaries with weak currents the types of substrate are mud and clay; if the current is strong, you will find a lot of sandy substrate because only large particles settle more quickly than smaller particles. In waters where high levels of ammonia compounds are found, it will increase the growth and density of phytoplankton (Toro et al., 2024).

The presence of plankton in appropriate amounts can have a positive impact, but in excessive amounts it can disrupt the ecosystem, one example of which is eutrophication. Eutrophication is the rapid growth of aquatic plants in water bodies because these bodies contain nutrients. This can prevent sunlight from entering the water, thereby inhibiting the photosynthesis process and reducing dissolved oxygen levels in the water. The aquatic ecosystem is disturbed and loses balance (Pramaningsih et al. 2021). Plankton acts as natural food for

aquatic organisms (Nontji, 2008). The fertility of waters can be characterized by the abundance of phytoplankton and zooplankton (Fitriani et al., 2019). Furthermore, Pearson and Rosemberg in Lardicci et al. (1997) stated that the organic material content in the substrate will influence the structure of the macrozoobenthos community.

Changes in water quality are closely related to water potential, especially in terms of phytoplankton diversity and composition. The presence of plankton in a body of water can provide information about the condition of a body of water, so plankton is a biological parameter that can be used as an indicator to evaluate the quality and level of fertility of a body of water. There are types of plankton that live and bloom due to certain substances, so they can provide an overview of the real state of a body of water (Fachrul, 2005). Patty (2013) stated that the high levels of dissolved oxygen in offshore waters are because the water is clear so that oxygen can easily enter the water without obstacles through the process of diffusion and photosynthesis.

The Wiringtasi River is one of the rivers in Barru Regency, South Sulawesi, Indonesia, which has experienced many uses, including the river having a river mouth that directly faces the sea so that it can be an entry point for fishermen. Along the river there are also stretches of ponds and rice fields, all of which will affect the existence of the ecosystem in the river, including the presence of plankton. Regarding the presence of plankton, there are several parameters that are observed, namely diversity, abundance, uniformity and dominance. The existence of plankton is very important to study because each environmental condition will influence the existence of plankton, and the presence of plankton will influence the biota in the ecosystem.

MATERIALS AND METHODS

This research was conducted in the Wiringtasi River, Barru Regency, Indonesia. The research was carried out at three research locations, namely location 1, namely the river location adjacent to rice fields, location 2, namely the river area adjacent to ponds and beaches, and location 3, namely the location around the mouth of the Wiringtasi River, Barru Regency. Plant analysis was carried out at the Chemistry and Water Laboratory of the Pangkep State Agricultural Polytechnic. This research is descriptive observational research.

The research began by taking 100 L of water at the surface (30 cm) at each predetermined station, then filtering the water using a plankton net 25. After filtering, the water sample was transferred to a Winkler bottle and given 1% formalin. The water samples were then immediately identified for the type and amount of plankton based on the plankton identification key book from Nedham & Nedham (1963) and Smith (1950). The plankton identification process is carried out by taking a 1 ml water sample using a pipette and then dropping it on the sedgewick rafter. Observations were carried out under a microscope with a magnification of 40x10 (Grace Analytical Lab. 1994).

The plankton samples obtained were calculated for abundance, species diversity, species uniformity, and dominance index. The abundance of plankton in the Wiringtasi River, Barru Regency, is calculated using the following formula (APHA, 1989):

$$N = F \times \frac{Ja}{Jb} \times \frac{vt}{Vs} \times \frac{1}{Vd}$$

Where:

- N = Plankton abundance (ind/l)
- Vd = Volume of filtered water (10 L)
- Vt = Volume of filtered water (30 ml)
- Ja = Receptacle area (1000 mm^2)
- Jb = Total area of visual field analyzed (100 mm^2)
- Vs = Volume of water that analyzed (3 ml)
- F = Number of biota found (ind)

Diversity is analyzed using the following formula (Mason, 2002):

$$H' = \sum_{t=1}^{n} (Pi) In(Pi)$$

Where:

- H' = Diversity
- Pi = Proportion of 1st type in community (ni/N)
- In = Number of i-th species
- N = The total number of all species

The Diversity Index (H') value ranges between:

0<H1<2,3 = Little diversity
2,3<H1<6,9 = Medium diversity
H1>6,9 = Great diversity.

According to Arinardi et al. (1996) the uniformity index can be calculated using the formula:

$$e = \frac{H'}{H' \text{ maks}}$$

Where:

e = Uniformity index
H' = Diversity index
H' maks = ln number of genus(s) for phytoplankton
$\log^2$ number of genus(s) for zooplankton

Criteria According to Krebs (1985):

e < 0,4 = Low category
0,4 < e < 0,6 = Medium category
e > 0,6 = High category

The dominance index is analyzed using the following formula (Odum, 1994):

$$C = \sum_{t=1}^{n} (ni/N)^2$$

Where

C = Dominance Index
Ni = Number of individuals of the type to-i
N = Total number of individuals

The data obtained was then analyzed using descriptive analysis. Descriptive analysis is a research method by collecting data according to the truth, then the data is compiled, processed, and analyzed to provide an overview of the problems in the research.

RESULTS AND DISCUSSION

Level of Diversity

Figure 1 shows that the level of plankton diversity at the research location is highest at location 1, namely the location adjacent to the rice field area with a diversity value of 1.552158, and the location with the lowest diversity value is at location 2, namely the location adjacent to the pond and beach area, namely 0.1059974. However, the level of plankton diversity for all locations is still relatively small because it is still in the range below 2.3 (<2.3) (Mason, 2002), but if we refer to the opinion of Heip et al. (1998), the level of diversity at location 1, namely the location adjacent to the rice fields, is still in the medium category with a value of 1≤H≤3.

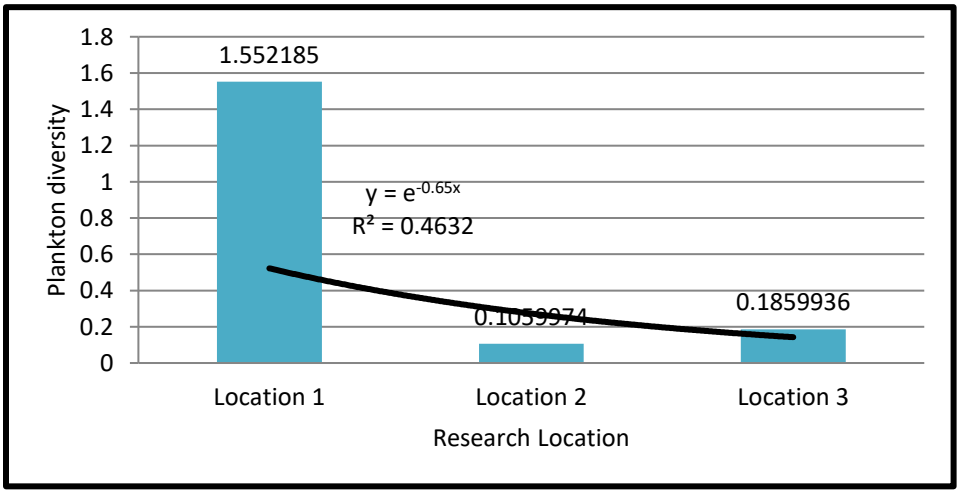

Figure 1. Level of Plankton Diversity at the research location

In contrast to the results of research conducted by Anggara et al. (2017), who found that plankton diversity in the Tlogo Dringo Nature Reserve Area, Dieng Plateau, Central Java, was in the medium category. According to Heip et al. (1998), if diversity 1≤H≤3 indicates moderate species diversity, sufficient water productivity, fairly balanced ecosystem conditions, and moderate ecological pressure. To increase aquatic productivity, stability of the aquatic ecosystem is required, for example in terms of the availability of food and oxygen so that the life-supporting components of aquatic biota are maintained (Anggara et al., 2017). Differences in environmental characteristics and parameter values for each station also influence plankton diversity (Sari et al., 2021). Stable waters with high phytoplankton diversity allow for the presence of more biota at higher trophic levels so that aquatic productivity will also increase (Anggara et al., 2017). Afif et al. (2014) explained that one of the environmental factors that influences species diversity is the type of basic substrate. The level of plankton diversity in waters is influenced by abiotic factors including DO, BOD, pH, temperature, and current speed (Oktavia et al. 2015). According to Veronica et al. (2014), waters with a low fertility level have a plankton density of less than 104 ind/L, medium fertility is higher than 104 ind/L, and very high fertility is above 107 ind/L. Plankton with a density level above 107 ind/L is called blooming.

Abundance (cells/ml)

The abundance of plankton at location 1 shows that the highest plankton abundance is *Melosira* sp type plankton with a plankton abundance level of 1350 cel/ml, and the type of plankton with the lowest plankton abundance level is Bloetheca sp and *Oscilatoria* sp plankton with each plankton abundance value of 50 cells/ml (Figure 2).

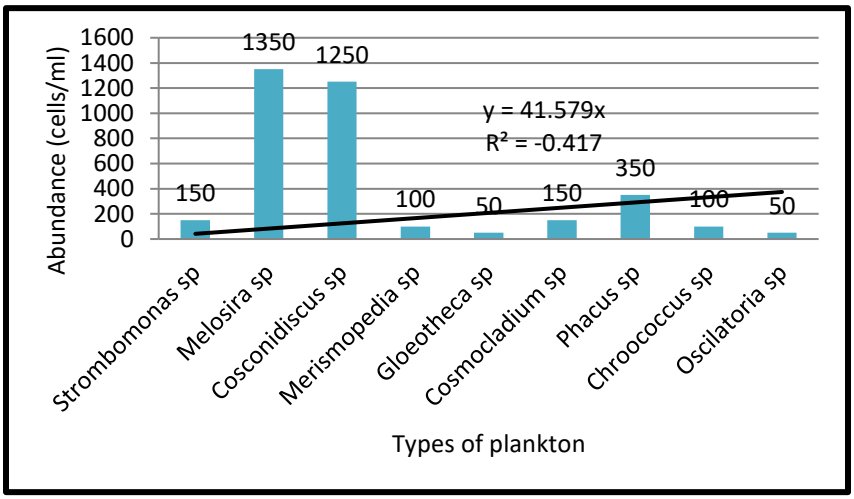

Figure 2. Plankton abundance at location 1

Figure 3 shows that the highest level of plankton abundance at location 2 is in the *Navicula* sp type plankton, namely 3000 cells/ml, and the lowest plankton abundance is in the *Rhizosolenia* sp, *Chaetoceros* sp, *Synedra* sp, *Merismopedia* sp, *Pleurosigma* sp, and *Ulotrix* sp, with the respective plankton abundance value being 50 cells/ml.

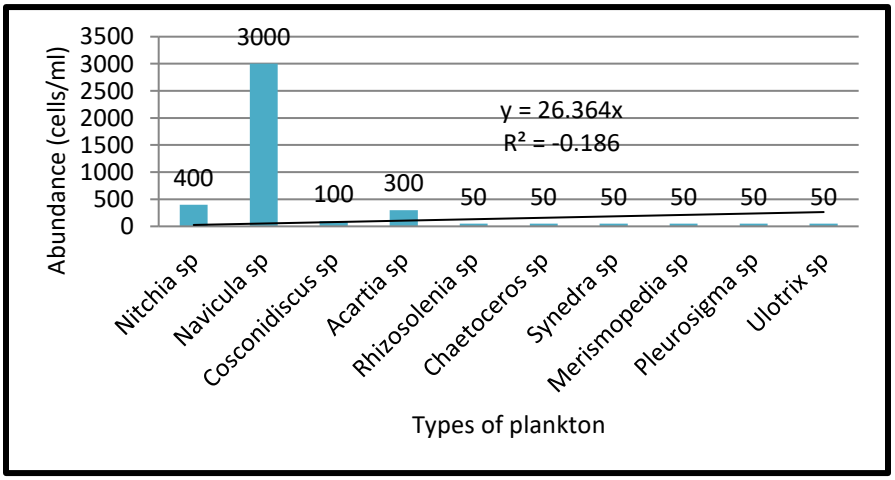

Figure 3. Plankton abundance at location 2

Figure 4 shows that the highest level of plankton abundance is found in the Navicula sp type plankton, which has an abundance of 1650 cells/ml, and the type of plankton with the lowest level of abundance is the Diatom asp type plankton, namely 50 cells/ml.

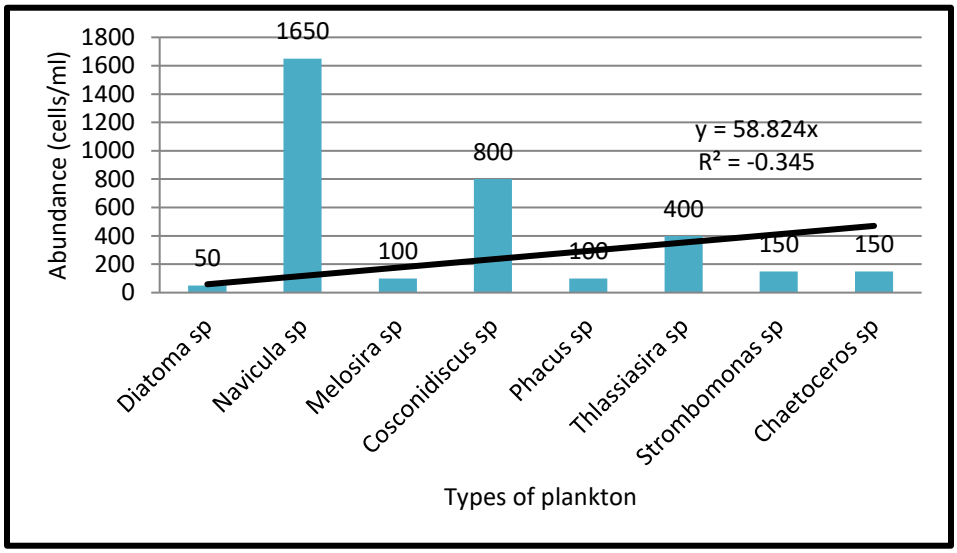

Figure 4. Plankton abundance at location 3

The total abundance of all plankton found in Tlogo Dringo was 69,904 ind/L, with the abundance of phytoplankton being higher than the abundance of zooplankton. The abundance of phytoplankton from each class shows that the highest abundance is in the Chlorophyceae class, namely 38,517 ind/L. In the Bacillariophyceae class, *Synendra* sp. is the type that has the highest abundance of other types, with an abundance of 7,446 ind/L (Anggara et al., 2017). The results of testing plankton abundance in the laboratory on the Jeneberang River showed an abundance of between 3418 ind/L to 13158 ind/L (Alfionita et al., 2019). The abundance of plankton in the Jeneberang River shows that the highest abundance of plankton is at station 5, namely in the downstream part of the Jenebrang River, precisely in the coastal area with an abundance value of 13,158 ind/L. This is because the area receives a lot of input from outside, which comes from dense settlements around the observation location, domestic waste, and floating net cage feed waste. The lowest abundance was at station 1, namely 3428 ind/L (Alfionita et al., 2019). This location is an upstream area where the nutritional content is less than the existing nutritional content. Plankton are organisms that are sensitive to environmental changes. The abundance, diversity, and dominance of plankton in waters can be used as an indicator of whether the waters are still in good condition or have experienced disturbances (Romimohtarto & Juwana 2001). This is supported by the statement by Kusmeri & Dewi (2015) that plankton has high abundance and diversity values at a relatively shallow depth level.

Uniformity Index

Figure 5 shows that the plankton uniformity index at the research location is highest at location 1, namely the location close to the rice fields with a uniformity index value of 0.70642991, and the location with the lowest uniformity level is location 2 with a uniformity index value of 0.04603411. The uniformity index value at location 1 is in the high category because it is greater than 0.6 ($e > 0.6$) (Krebs, 1985). Meanwhile, the uniformity index value for other locations is classified as low when referring to Krebs (1985) because it is lower than 0.4 ($e < 0.4$). The results of research conducted by Anggara et al. (2017) who conducted plankton research in Tlogo Dringo, showed that plankton uniformity was $0.4 \leq E \leq 0.6$, meaning it shows moderate uniformity or the same type of aquatic biota in the medium category. A moderate uniformity index shows that each type of plankton is distributed evenly throughout the observation location (Anggara et al., 2017).

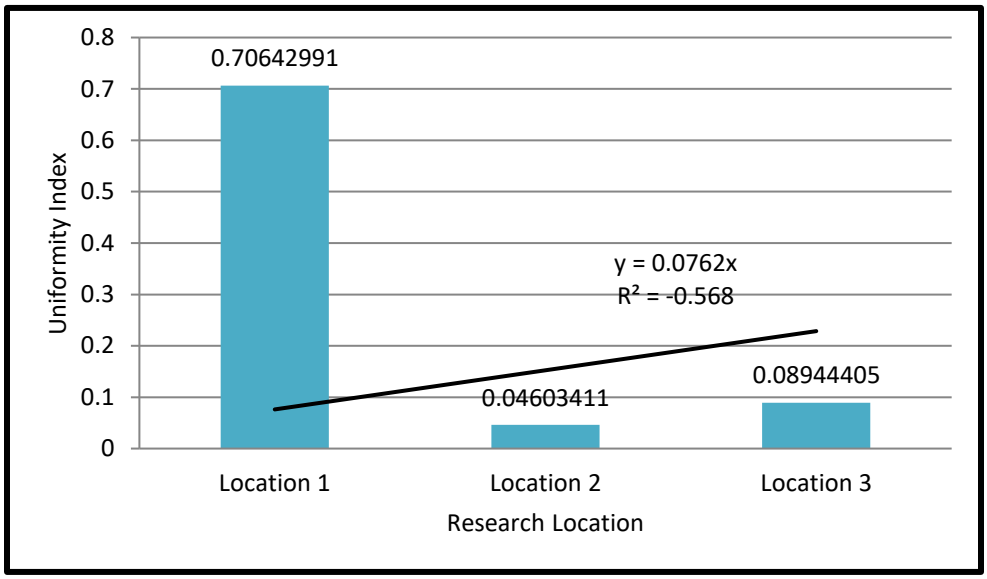

Figure 5. Plankton Uniformity Index at the research location

Dominance (ni/N) = pi)

At location 1 (Figure 6), it shows that the highest level of plankton dominance (ni/N) = pi is in the plankton type *Melosira* sp, namely 0.3802816, and the lowest level of plankton dominance is in the plankton types *Gloeotheca* sp and *Oscilatoria* sp, respectively, with a dominance value of 0.0140845. The research results of Anggara et al. (2017) show that there is no dominant type. Each type of plankton is able to associate well in an ecosystem so that no factors are found that cause ecological pressure from certain types of plankton.

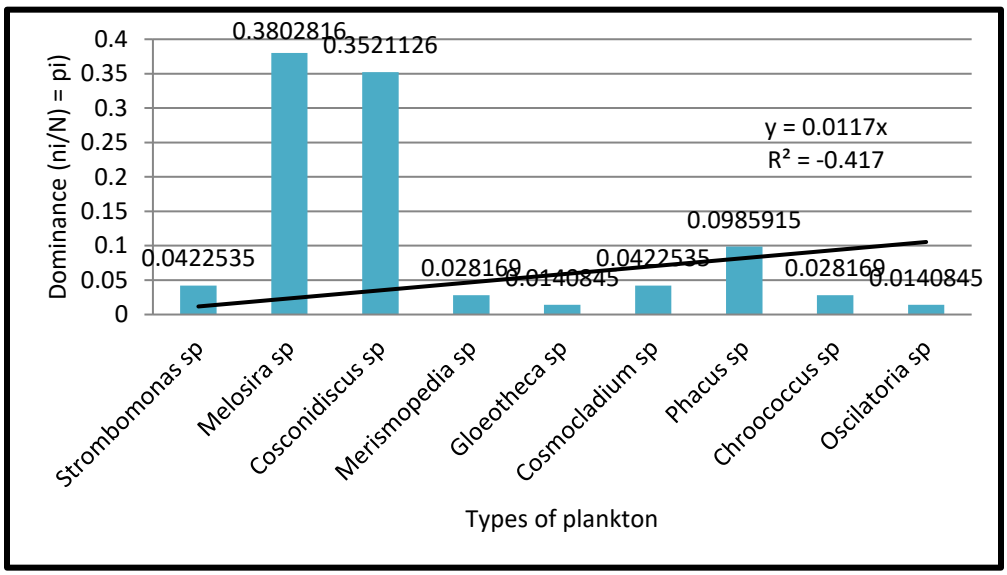

Figure 6. Dominance of plankton at location 1

At location 2 (Figure 7) it shows that the highest level of plankton dominance is found in plankton of the *Navicula* sp type with a dominance value of 0.731707, and the lowest dominance value is in plankton of the types *Rhizosolenia* sp, *Chaetoceros* sp, *Synedra* sp, *Merismopedia* sp, *Pleurosigma* sp, and *Ulotrix* sp, namely 0.0121951.

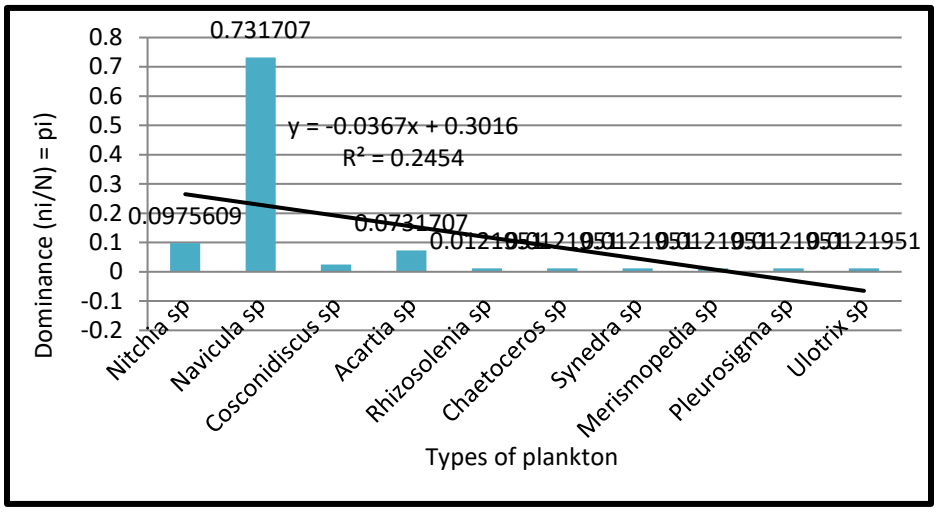

Figure 7. Dominance of plankton at location 2

At location 3 (Figure 8), the highest plankton dominance is found in the *Navicula* sp type plankton, namely 0.4852941, and the type of plankton with the lowest dominance value is the *Diatoma* sp, namely 0.0147058. Anggita et al. (2012) stated that human activity has an influence on the observed water conditions, which causes the number of species to increase so that they dominate the waters. Kusmeri & Dewi (2015) say that a species dominance index value that is close to 0 indicates that in that community there is no dominant organism. Conversely, if the dominance index value is close to 1, it indicates that the community has a dominant organism. Each station has low dominance due to the lack of plankton found during the research, which affects the species dominance index (Novrilianty et al., 2022). Uneven abundance tends to cause one type of phytoplankton to dominate. This results in blooming at any time. If there are excess nutrients in the waters. In general, based on the category of phytoplankton and zooplankton abundance based on the fertility of the waters at the research location, they are included in mesotrophic waters or moderate fertility (Alfionita et al., 2019).

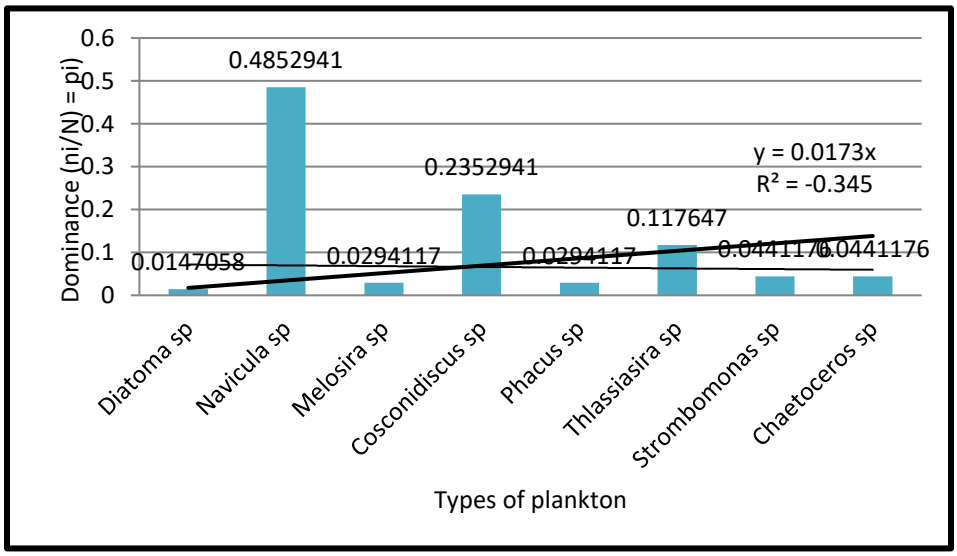

Figure 8. Dominance of plankton at location 3

CONCLUSION

The abundance of plankton at location 1 shows that the highest plankton abundance is Melosira sp. At location 2, the highest plankton abundance is Navicula sp. The level of plankton diversity at the research location was highest at location 1, namely the location adjacent to the rice field area, with a diversity value of 1.552158. The plankton uniformity index at the research location was highest at location 1, namely the location close to the rice fields with a uniformity index value of 0.70642991. Furthermore, the highest level of plankton dominance at location 1 is the Melosira sp. type plankton at locations 2 and 3, namely the Navicula sp. are type plankton with respective dominance values of 0.731707 and 0.4852941.

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