Community structure of zooplankton in seagrass beds in the bay of Balikpapan City, East Kalimantan

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ABSTRACT

Zooplankton is a component in the food chain that has an important role in the production value of an ecosystem, this is because zooplankton is the main connecting link between phytoplankton and nekton. The purpose of this study was to determine the types of zooplankton found in the seagrass beds of Balikpapan Bay and to determine the value of diversity, uniformity and dominance of zooplankton in the waters of Balikpapan Bay. Measurement of water quality parameters was carried out at the Water Quality Laboratory of the Faculty of Fisheries and Marine Sciences. This research was conducted in November - December 2022 in the waters of the Bay of Balikpapan City using the consideration method (Purposive Sampling Method) to determine the research station and use the method Sedgewick Rafter for the identification stage the data were analyzed by calculating zooplankton abundance, diversity index, uniformity index and dominance index, then the data were analyzed using Microsoft Excel. The abundance of zooplankton in the waters of Balikpapan City Bay consisted of 2 classes, namely copepods and oligotrichea, while for the abundance of zooplankton the results were different at station 1, the value was 1134 ind/L at station 2, the result was 567 ind/L and at station 3, the value was obtained 252 ind/L for station 1 and 2 of the highest species is the crime of murderand at station 3 the highest species Tintinnopsis open. The diversity index value in Balikpapan Bay waters is categorized as moderate species, the uniformity index value in Balikpapan Bay waters is categorized as relatively stable and the dominance index value in Balikpapan Bay waters is categorized as no dominant species.

INTRODUCTION

Balikpapan Bay is one of the areas with the richest natural potential in Kalimantan, especially in East Kalimantan. The biodiversity in Balikpapan Bay includes seagrass beds. Seagrasses are flowering aquatic plants adapted to living in marine environments. They can thrive in saline water, function normally while submerged, have a well-developed root system, reproduce generatively underwater, and compete with other organisms in stable or unstable conditions (Hutomo and Azkab, 1987).

Plankton is divided into two categories: phytoplankton and zooplankton. Zooplankton, like other organisms, reproduce well in suitable aquatic conditions, including marine environments. If the water conditions and the availability of phytoplankton do not meet the needs of zooplankton, they cannot survive and will seek more suitable conditions (Suherman 2005 in Desmawati et al., 2020).

Zooplankton is a crucial component in the food chain, measured in relation to the productivity of an ecosystem. This is because zooplankton serves as the primary link between plankton and nekton (Odum, 1971 in Endrawati et al., 2000). Based on this background, the researcher is interested in conducting a study titled "Community Structure of Zooplankton in Seagrass Beds in the Waters of Balikpapan Bay, Balikpapan City, East Kalimantan."

METHODOLOGY

This research was conducted from November 2022 to March 2023. The field research took place in the Kampung Baru Pelindo 4 Port area, Balikpapan Barat District, Balikpapan City. The research was carried out in two stages: the first stage involved sample collection and in-situ field measurements, and the second stage involved phytoplankton identification and water analysis. The research procedure included field observations, station determination, water sample collection, measurement of water quality parameters, data analysis, and preparation of the final report.

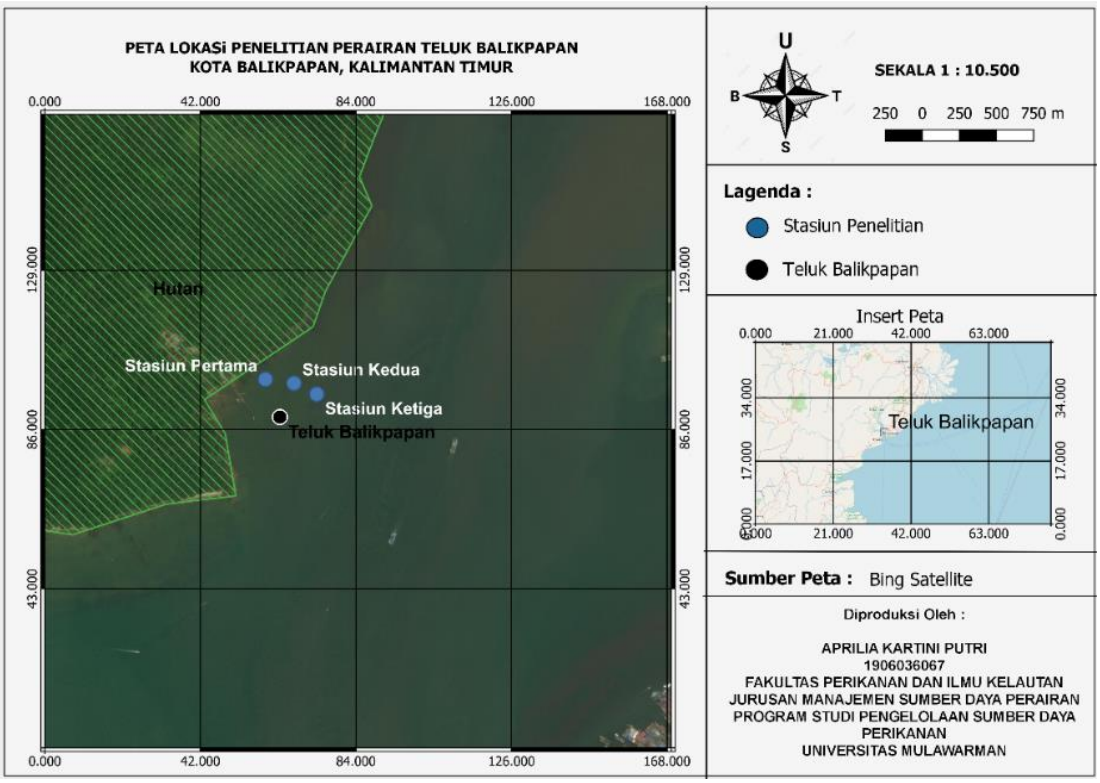

Figure 1. Study location map

The determination of research station locations was carried out through preliminary surveys and the presence of seagrass. The selection of research locations used the purposive sampling method, which involves choosing sample collection locations based on specific objectives and considerations as well as the research targets. Station determination was based on initial observations and was divided into three stations: station 1, station 2, and station 3, each 20 meters apart.

Equipment and Materials

Materials used in sample collection include water samples, plankton samples, aquadest, Lugol's solution, and DO titration. The equipment used includes a plankton net, sample bottles, thermometer, hand

refractometer, Secchi disk, a set of DO titration tools, GPS, microscope, camera, stationery, cool box, boat, current ball, plankton identification book, water sampler, rope bucket, object glass, and cover glass.

Preparation Stage

An initial field survey was conducted to determine a clear overview of the research site's general conditions and to prepare the research equipment.

Station Determination Stage

The research site location was determined in the Teluk Balikpapan area using the purposive sampling method, which involves selecting sampling locations based on specific objectives and considerations. The research stations were divided into 3 stations, namely station 1, station 2, and station 3, each located 20 meters apart.

Sample Collection

Samples were collected and observed using a microscope to examine the form and types of zooplankton. The first step involved taking a drop of water sample, placing it on an object glass, covering it with a cover glass gently, and then placing it under the microscope with a magnification of 100x to obtain clear objects. Zooplankton identification was conducted at the Water Quality Laboratory of the Faculty of Fisheries and Marine Sciences.

Identification Technique

Samples were observed using a microscope to examine the form and types of zooplankton, and identification was performed using the plankton identification book "Oceanographic Characters and Plankton Resources of Indonesia" by Agus Hartoko and the World Register of Marine Species application. The Sedgewick-Rafter method was employed with 3 repetitions. Zooplankton identification was conducted at the Water Quality Laboratory of the Faculty of Fisheries and Marine Sciences.

Measurement of Water Quality Parameters

Water quality parameters measured in this study include temperature, salinity, transparency, current velocity, DO, pH, nitrate, and phosphate. Temperature, transparency, current velocity, and DO were measured in situ in the field, while salinity, pH, nitrate, and phosphate measurements were conducted at the Water Quality Laboratory of the Faculty of Fisheries and Marine Sciences, Universitas Mulawarman.

RESULTS AND DISCUSSION

Water Quality Parameters

The water quality parameters measured at the research stations included both physical and chemical parameters. The physical parameters were temperature, transparency, and current speed, while the chemical parameters were dissolved oxygen (DO), pH, phosphate (PO4), salinity, and nitrate (NO3).

Table 1. Water quality parameters

Parameter	Station 1	Station 2	Station 3	Standard*
Temperature	30℃	30℃	29℃	28-30℃
Salinity	25 ‰	24‰	21‰	33-34‰
Water clarity	1 m	1,15 m	1,20 m	>3 m
Water velocity	0,20 m/s	0,23 m/s	0,28 m/s	-
pH	7,55	7,80	7,63	7-8,5
DO	6,8 mg/l	6,25 mg/l	5,91 mg/l	>5 mg/l

Nitrate	0,015 mg/l	0,027 mg/l	0,018 mg/l	>0,015 mg/l
Phosphate	0,021 mg/l	0,029 mg/l	0,032 mg/l	>0,008 mg/l

Standard*: KEPMEN-LH No. 51 Tahun 2004

According to Kadir et al. (2015), the optimal temperature for phytoplankton life is 25-30ºC. The quality standard according to KEPMEN LH No. 51 of 2004 is 28-30ºC. The measured temperatures in the waters of Balikpapan Bay were 30ºC at station 1, 30ºC at station 2, and 29ºC at station 3. The temperatures in Balikpapan Bay waters are within the optimal range for phytoplankton to thrive.

Salinity is the concentration of all salt solutions found in seawater, where salinity affects the osmotic pressure of the water; the higher the salinity, the higher the osmotic pressure (Hamuna et al., 2018). According to Nontji (2007), phytoplankton develops well at salinities between 20-32‰. According to KEPMEN LH No. 51 of 2004, the salinity quality standard for marine biota is 33-34‰. The measured salinity in the waters of Balikpapan Bay was 25‰ at station 1, 24‰ at station 2, and 21‰ at station 3. The lower salinity levels in Balikpapan Bay waters are due to high rainfall.

High pH values in a body of water can affect the growth rate of phytoplankton. The pH of seawater is considered a major factor limiting the growth rate of phytoplankton, with an optimal range of 7.0-8.5. The measured pH values in Balikpapan Bay waters were 7.55 at station 1, 7.80 at station 2, and 7.63 at station 3, indicating normal pH levels for phytoplankton growth.

According to KEPMEN LH No. 51 of 2004, the quality standard for marine biota, especially seagrass, is >3. During the transparency measurement in the research location, a 100% transparency was observed due to measurements taken at low tide. Shallow waters allow sunlight to reach the bottom, increasing water temperature. The measured transparency in Balikpapan Bay waters was 1 meter at station 1, 1.15 meters at station 2, and 1.20 meters at station 3.

The measured current speeds in Balikpapan Bay waters were 0.20 m/s at station 1, 0.23 m/s at station 2, and 0.28 m/s at station 3, all within the moderate current speed category. These measurements were taken during the lowest tide conditions in the afternoon, aligning with the moderate current speed range of 0.25-0.50 m/s.

Dissolved oxygen levels result from photosynthesis by seagrass and phytoplankton (Effendi, 2003). DO is the amount of oxygen gas dissolved in water, measured in mg/L. According to Kep. Men LH No. 51 of 2005, the quality standard for marine biota, especially phytoplankton, is >5 mg/L. The measured DO levels in Balikpapan Bay waters were 6.08 mg/L at station 1, 6.25 mg/L at station 2, and 5.91 mg/L at station 3, indicating optimal environmental conditions for seagrass ecosystems.

According to Wardoyo (1982), the optimal nitrate concentration for phytoplankton growth is 0.9-3.5 mg/L. The quality standard for marine biota is 0.008 mg/L according to KEPMEN LH No. 51 of 2004. The measured nitrate levels in Balikpapan Bay waters were 0.015 mg/L at station 1, 0.027 mg/L at station 2, and 0.018 mg/L at station 3, all higher than the quality standard, indicating potential pollution. According to Wardoyo (1982), the optimal phosphate concentration for phytoplankton growth is more than 0.02 mg/L, influencing growth and photosynthesis. The measured phosphate levels in Balikpapan Bay waters were 0.02 mg/L at station 1, 0.020 mg/L at station 2, and 0.032 mg/L at station 3. The quality standard for marine biota is 0.015 mg/L according to KEPMEN LH No. 51 of 2004. The phosphate levels in Balikpapan Bay waters exceed the quality standard, potentially causing pollution and eutrophication.

Zooplankton composition

Based on the research conducted at each station (station 1, station 2, and station 3) in the waters of Teluk Balikpapan, Kota Balikpapan, only two classes of zooplankton were found: Copepoda and Oligotrichea. These classes consist of 9 genera: Acartia, Eurytemora, Microstella, Oithona, Polyarthra, Trigripus, Dictyocysta, Rhabdonella, and Tintinnopsis, totaling 19 species of zooplankton. Copepoda were found almost universally across all stations. Copepoda are commonly found in marine waters, with the order Calanoida being the most easily encountered and considered crucial in the food chain (Mauchline, 1998). According to Nybakken (1992), Copepoda are the most commonly found holoplankton in the sea and dominate marine environments. Mulyadi and Radjab (2015) state that the dynamics or variation in zooplankton composition is generally influenced by food availability, suitable environmental conditions, competition, predation factors, and the vertical migration of zooplankton. Based on the research findings in the waters of Teluk Balikpapan, Kota Balikpapan, East Kalimantan, at the 3 different stations, the zooplankton found can be observed in Figure 2.

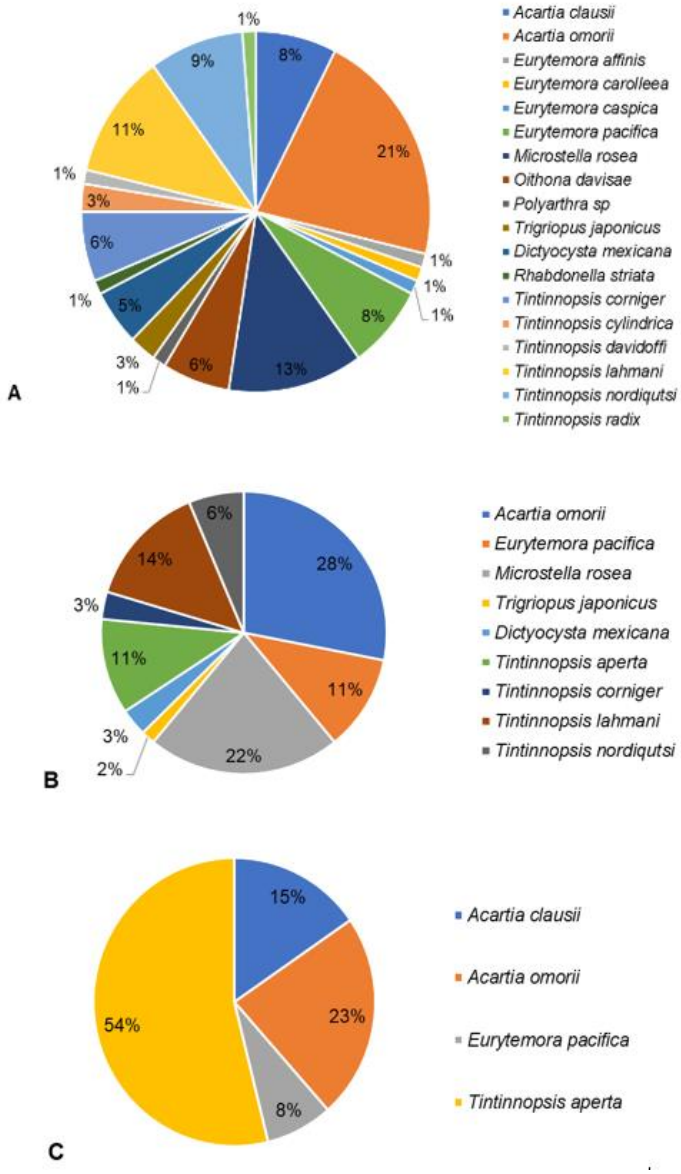

Figure 2. Zooplankton composition: A) Station 1; B) Station 2; C) Station 3

Abundance

Based on the findings from Figure 3, the abundance of zooplankton ranges from 1134 to 252 ind/L across the different stations in Teluk Balikpapan, Kota Balikpapan. Specifically, station 1 recorded 1134 ind/L, station 2 recorded 567 ind/L, and station 3 recorded 252 ind/L. The highest abundance of zooplankton species at station 1 is *Acartia omorii*, while both *Acartia omorii* and *Tintinnopsis aperta* are predominant at stations 2 and 3, respectively. *Tintinnopsis aperta* belongs to the class Oligotrichea. Species like *Acartia* sp., which belong to the class Copepoda, dominate the aquatic ecosystem with populations ranging from 70% to 90% (Meadows and Campbell, 1993).

Analysis of Diversity Indices (H'), Evenness (E), and Dominance (C)

The analysis shows a range of 1.157 to 2.501 across the stations. Station 1 has an H' value of 2.501, station 2 has 1.904, and station 3 has 1.157. Based on the Shannon-Wiener classification (Heip et al., 1998), an H' value of $1 \leq H' \leq 3$ indicates moderate species diversity. Therefore, the zooplankton diversity in Teluk Balikpapan can be classified as moderate ($1 \leq H' \leq 3$). The evenness index ranges from 0.867 to 0.835 across the stations. Station 1 has 0.865, station 2 has 0.867, and station 3 has 0.835. According to Bengen (2000), an evenness index approaching 0 suggests dominance by certain species, whereas an index approaching 1 indicates relative stability. The evenness index in Teluk Balikpapan suggests relative stability. The dominance index ranges from 0.105 to 0.373 across the stations. Station 1 has 0.105, station 2 has 0.177, and station 3 has 0.373. According to Simpson (1949), a dominance index of $0 < C < 0.5$ indicates no species dominance. The dominance index in Teluk Balikpapan indicates that no single species dominates the zooplankton community.

CONCLUSION

1. The research in Balikpapan Bay identified 2 classes of zooplankton: Copepoda and Oligotrichea. Copepoda consisted of 10 species of zooplankton, while Oligotrichea had 9 species. The highest species counts were Acartia omorii in stations 1 and 2, and Tintinnopsis aperta in station 3.
2. The diversity index of zooplankton in Balikpapan Bay ranged from 2.501 to 1.157, indicating a moderate diversity level ($1 \leq H' \leq 3$). The evenness index of zooplankton across the 3 stations ranged from 0.867 to 0.835, indicating relative stability in species distribution in Balikpapan Bay. The dominance index of zooplankton ranged from 0.373 to 0.105 across the stations, suggesting no dominant species in Balikpapan Bay.

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