Original Research Article

PLANKTON COMMUNITY STRUCTURE IN THE MANGROVE WATERS OF LEUWEUNG SANCANG NATURE RESERVE, GARUT REGENCY

ABSTRACT

This study aims to determine the structure of plankton communities as an estimator of water quality status in the Leuweung Sancang Nature Reserve, Garut Regency, West Java. This research was conducted on October 19 – November 8, 2021. Sampling was carried out at five stations, namely located close to settlements and having a small mangrove area, on the outskirts of the Cipalawah River so that mangrove areas get nutrients from rivers, in delta areas facing tides and rivers, behind deltas that do not directly get nutrients from the sea or rivers and areas that directly face seawater and have the largest mangrove area. The results showed that plankton abundance ranged from 2840 – 3835 ind / L and had a saprobic index ranging from 1.10 – 1.13. Based on the results of the study, the abundance of plankton in the Leuweung Sancang Nature Reserve is categorized as moderate and indicated by mild pollution as seen from the saprobic index.

Keywords: Plankton, Leuweung Sancang Nature Reserve, Abundance, Saprobic Index

1. INTRODUCTION

Plankton is a microorganism that lives in mangrove areas that are part of the food chain in the mangrove forest ecosystem. Plankton is a source of energy for other beings in an ecosystem. Plankton is divided into two main groups, namely phytoplankton, namely plankton which is plant, while zooplankton, namely plankton which is animal (1). Phytoplankton are the basis of the food chain and are called primary producers. Plankton can also form organic matter through the process of photosynthesis which can then be utilized directly by other living organisms. According to there are various types of organisms and zooplankton that are able to consume detritus from the leaves of 87 mangrove trees and play a role in the decomposition process of organic matter [1].

According to the basic components of the food chain of the mangrove ecosystem derived from litter derived from mangrove plants (leaves, branches, fruits, stems and so on) part of the mangrove litter is decomposed by bacteria and fungi into nutrients such as Nitrogen and Phosphorus which are dissolved and can be utilized directly by phytoplankton. According to [2], mangroves have biological functions, namely as spawing grounds, nursery grounds, feeding grounds and sanctuaries. One of the mangrove areas that has a biological function for fish, shrimp and plankton is the Leuweung Sancang Nature Reserve [2].

Leuweung Sancang Nature Reserve has an area of 2157 ha. The state of the Leuweung Sancang Nature Reserve has been eroded year by year and its peak occurred during the economic and post-reform crisis. Massive forest encroachment occurred in 1998 - 2003 in the Leuweung Sancang Nature Reserve forest area with a total damage of 1725.6 ha or about 80% of the total forest area of the Leuweung Sancang Nature Reserve. The destruction of this forest is by forest encroachment and illegal settlements within the Leuweung Sancang Nature Reserve area, even so in 2004 it was carried out land rehabilitation by planting various types of crops, but the results of land rehabilitation could not replace the ecosystem that had already been damaged [3].

This study aims to obtain information about the status of water quality and plankton community structure in the mangrove waters of the Leuweung Sancang Nature Reserve. The results of this study are expected to provide information about the status of water quality and the structure of plankton communities in the mangrove waters of the Leuweung Sancang nature reserve. Provide a factual background, clearly defined problem, proposed solution, a brief literature survey and the scope and justification of the work done.

2. MATERIAL AND METHODS

2.1 Place and Time of Research

This study aims to obtain information about the status of water quality and plankton community structure in the mangrove waters of the Leuweung Sancang Nature Reserve. The results of this study are expected to provide information about the status of water quality and the structure of plankton communities in the mangrove waters of the Leuweung Sancang nature reserve. Provide a factual background, clearly defined problem, proposed solution, a brief literature survey and the scope and justification of the work done.

2.2 Tools and Materials

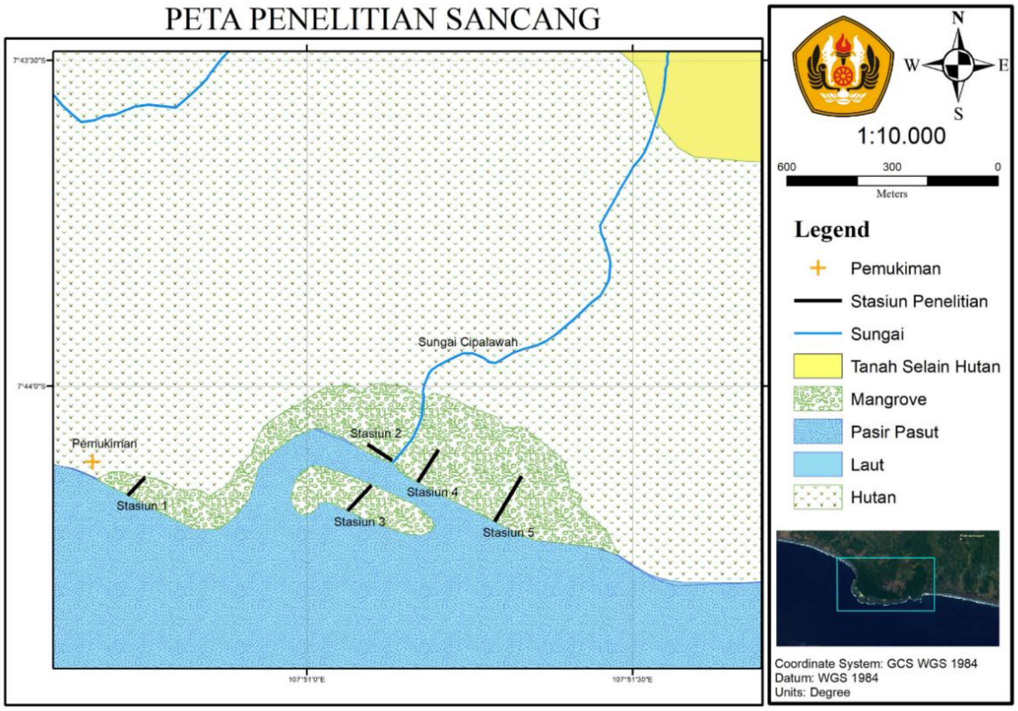
The following are the tools and materials used in the study:
The tools used in this study, namely

1. Sample bottle, for plankton container and water container
2. Plankton Net number 20 µm Filtering Plankton
3. pH Meter for Measuring Acidity
4. Thermometer for measuring temperatur
5. Refractometer for measuring salinity
6. Do Meter for measuring Dissolved Oxygen
7. Spectrophotometer for measuring nitrates and phosphates
8. Camera for research documentation
9. Dipper Vol 1L for taking sample water
10. Cool box to bring water and plankton samples and maintain the quality of samples
11. Miscroscope for analysis plankton

The materials used in this study are plankton sample and water samples

2.3 Research Methods

This research was conducted by a survey method with a purposive sampling approach based on land use and nutrient inputs. The determination of the station considers several things, namely domestic activities (settlements), nutrients that enter the mangrove area, and the area of the mangrove area. The map of the study location can be seen in Figure 1.



Research stations for sampling are located in five locations, namely:

Figure 1. Sancang Map Research

Station 1: The location is close to the settlement and has a small mangrove area and gets fewer nutrients with coordinates 7°45'10" S and 107°50'43" W.

Station 2: The location is on the outskirts of the Cipalawah River so that this mangrove area gets nutrients from the river area with coordinates 7°44'7"S and 107°51'8" W.

Station 3: The location is in the deltas area directly opposite the tides and gets nutrients from the sea with coordinates 7°44'11" S and 107°51'4" W.

Station 4: The location is behind the delta, so it does not directly get nutrients from the sea or river with coordinates 7°44'9" S and 107°51'10" W.

Station 5: The location that has the largest mangrove area with its coordinates located 7°44'13"S and 107°51'17" W.

2.4 Research Procedure

The research procedure carried out is as follows.

1. Stations are observed in the field and adjusted to the coordinates on the map.
2. Mangrove density and dominance data were taken using transect line plots (TLP).
3. DO, pH, Temperature, Salinity, brightness and tides of seawater are taken insitu data.
4. Plankton samples are taken at each station using plankton Net.
5. Water samples are taken using dippers and put into sample vials at each station for nitrate and phosphate measurements
6. The water sample is preserved with 4% lugol and put in Cool Box.
7. Plankton samples and water quality measurements were identified at the Aquatic Resources Management Laboratory of Padjadjaran University.

2.5 Data Analysis

The data obtained then carried out data analysis to measure mangrove density, mangrove dominance, plankton abundance, plankton diversity and also plankton dominance and saprobic index were carried out with the following formula:

Density of a type (Ki) (stand/ha):

$$\text{Ki} = \frac{\sum \text{Individu suatu jenis mangrove}}{\text{Luas seluruh petak}}$$

Dominance of mangrove species (Di):

$$Di = \frac{Basal\ area\ suatu\ jenis\ (Ba)}{Luas\ seluruh\ petak}$$

The Basar formula of the area of a type (Ba) is:

$$Ba\ (m^2) = \frac{1}{4}\pi diameter\ pohon^2$$

The calculation of plankton abundance is measured trajectorially based on the Sedwick Rafter Counting Cell method, name [4].

$$\frac{\text{No.}}{\text{ml}} = \frac{\text{C x 1000 mm}^3}{\text{L x D x S}}$$

Information:
C: The number of organisms counted
L: The length of each pass (50 mm)
D: Sedwick-Rafter Depth (1 mm)
W: Pass width (1 mm)
S: Number of calculated passes (4 crosses)

The *diversity index* of plankton is calculated using the Shannon-Wiener formula [5].

$$H' = \sum_{i=1}^{n} pi \ln pi \ \ dengan\ pi = \frac{ni}{N}$$

Information:
H' = Shannon-Wiener Diversity Index
Ni = Number of i-th genus
N = Total number of genera

According to the range of the species diversity index, namely high species diversity if the H' value is > 3, the species diversity is moderate if the H' value = 1-3, and the type diversity is low if the H'<1 value [6].

Calculations that look at the presence or absence of dominating types in an ecosystem can be seen from the value of the Simpson dominance index with the following formula [5]:

$$D = \sum [\frac{ni}{N}]^2$$

Information:
D = Simpson Dominance Index
ni = Number of individuals of each type
N = Total number of individuals

Conditions value Index Dominance Range between 0-1. Value Index Dominance approach 0 show not exist genus the dominating. Value Index Dominance approach or more from 1 show the presence of genus the Dominant [7].

Table 1. Saphrobic Index with Biological Interpretation of Water Quality

Pollution Load	Degree of Pollution	Saprobic Phase	Saprobic Index
Many Organic Compounds	Very high	PolysaprobicPoly/α-Mesosaprobic	-3 to -2-2 to -1.5
Organic and Inorganic Compounds	A bit high	α-Meso/polysaprobikα-Mesosaprobic	-1.5 to -1-1 to -0.5
Few organic and inorganic compounds	Keep	α/β-Mesosaprobic β/α-Mesosaprobic	-0.5 to 00 to +0.5
	Lightweight/low	β-Mesosaprobikβ-Mesi/oligosaprobik	+0.5 to +1+1 to +1.5
	Very light	Oligo/ β-MesosaprobikOligosaprobik	+1.5 to +2+2 to +3

This calculation is based on the Dresscher and Mark method with saprobic index with the interpretation of biological water quality in Table 1. that is [4]:

$$X = (C + 3D - B - 3A)/(A + B + C + D)$$

Information:

- A: The Ciliata Group shows polysaprobity
- B: Euglonopyta group, showing α-Mesosaprobity
- C: Chlorococcales Group + Diatome shows β-Mesosaprobity
- D: Peridinae Group/Chlysophyceae/Conjugate, denoting Oligosaprobity

3. RESULTS AND DISCUSSION

3.1 General Condition of the Research Site

The research location is on the coast and estuary located Leuweung Sancang Nature Reserve in Garut Regency, West Java. Leuweung Sancang Nature Reserve is located at coordinates of coordinate points 07°41'48" S and 107°52'18" W found in Figure 2. Station 1 is at coordinates 07°44'09" S and 107°50'42" W which are directly opposite the sea and are near settlements. Data collection of station 1 was carried out on October 15, 2021 in the afternoon with a sandy substrate. Station 2 is at coordinates 07°44'09" S and 107°50'51" W which is directly opposite the mouth of the Cipalawah river which has a substrate of sand and mud. Data collection for station 2 was carried out on October 16, 2021 at noon. Station 3 is at coordinates 07°44'13" S and 107°51'07" W with coral and sandy substrates directly opposite the tides and the mouth of the Cipalawah river. Data collection of station 3 was carried out on October 16, 2021 in the morning. Station 4 is at coordinates 07°44'09" S and 107°51'10"W with muddy substrate. The tides at station 4 are blocked by the delta and are not directly opposite the Cipalawah River. Station 4 data collection was carried out on the morning of October 16, 2021. Station 5 of the study is at coordinates 07°44'13" S and 107°51'17" with a substrate of sand and mud directly opposite the tides. The data collection of station 5 was carried out on October 16, 2021 in the morning.

Stasion 1

Stasion 2

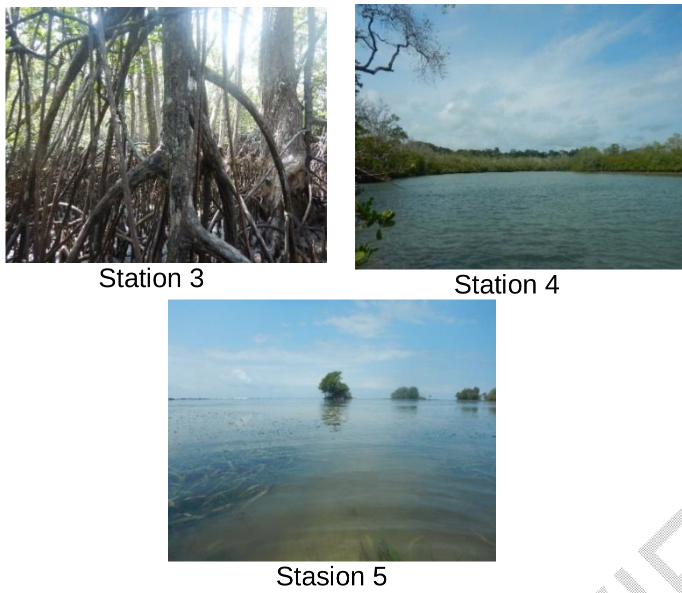


Figure 2. Condition of Mangrove Waters of Leuweung Sancang Nature Reserve

3.2 Mangrove Type Composition

Based on the results of research conducted in the Leuweung Sancang Nature Reserve, there is a composition of mangrove species that can be seen in Table 2.

Table 2. Mangrove Type Composition

No	Mangroves	Category
1	*Rhizophora apiculate*	Mangrove Major
2	*Rhizophora stylosa*	Mangrove Major
3	*Xylocarpus granatum*	Mangrove Minor
4	*Bruguierra gymnorrhiza*	Mangrove Major
5	*Sonneratia caseolaris*	Mangrove Major
6	*Sonneratia alba*	Mangrove Minor
7	*Aegiceras corniculatum*	Mangrove Minor

The types of mangroves found in the Leuweung Sancang Nature Reserve are major mangroves and minor mangroves. Major mangroves are mangroves that are composed of only one type of plant and minor mangroves are mangroves consisting of mixed types [8]

3.3 Mangrove Density

Mangrove density is the number of individual mangroves in a certain unit area in which the total stands of the mangrove type are known [9]. Table 3. showing the density of the mangrove type the union of the hektrar area with the whole at the observation site, it can be seen that each observation station has a different mangrove density. Leuweung Sancang Nature Reserve, as a whole station has very dense criteria according to the Ministry of Environment No. 201 of 2004.

Station 3 has the densest mangrove density, which is 153,333 ind/ha and station 2 has the lowest mangrove density with 31,667 ind/ha. Mangrove density can be seen in Table 3.

Table 3. Mangrove Density

Station	Density (Ind/ha)			
	Tree	Stake	Seedlings	Total
I	35000	40000	0	75000
II	21667	8333	1667	31667
III	78333	68333	6667	153333
IV	68333	46667	18333	133333
V	65000	33333	10000	108333

Mangrove density stations 1 and 3 are crowded with Sonneratia alba types because stations 1 and 3 face the tides directly and have a sandy dominant substrate. According to [10]. Sonneratia alba likes soils mixed with mud and sandy or sometimes found in rocks and corals, as well as types that are intolerant of fresh water over long periods.

The density of mangroves at station 2 is crowded with rhizopora apiculata species in the categories of trees, saplings and seedlings. Rhizopora apiculata grows on muddy and flooded soil substrates during normal tides, in addition to being present in tides that have a permanently strong freshwater input influence [10]. Station 2 also has mangrove species Bruguierra gymnorrhiza and Xylocarpus granatum growing in areas that have low salinity and dry and soils that have good aeration [10]. Stations 4 and 5 are crowded with types of Rhizopopra stylosa that grow in diverse areas such as, tides, muddy or sandy substrates, in addition, types of Rhizophora stylosa are also usually found in more open offshore locations [10].

3.4 Mangrove Dominance

Mangroves in Leuweung Sancang Nature Reserve have a different dominance for each station. Station 1 is the highest dominance in the Sonneratia alba type with 4.04 m^2/ha Station 2 is dominated by the Bruguierra gymnorhiza mangrove type which is 2.6 m^2/ha with 83% relative dominance. Stations 3, 4 and 5 have mangrove species with the highest dominance being Sonneratia alba with, station 3 numbers 1.55 m^2/ha, station 4 it amounts to 3,525 m^2/ha and station 5 has a dominance of 2,854 m^2/ha. Mangrove dominance can be seen in Table 3.

Table 4. Mangrove Dominance

Mangroves	D	DR (%)	D	DR (%)	D	DR (%)	D	DR (%)	D	DR (%)
	Station 1		Station 2		Station 3		Station 4		Station 5	
Sonneratia caseolaris			0,25	8						
Sonneratia alba	4,04	96			1,55	71	3,525	80	2,854	76,1
Rhizophora apiculata	0,532	1	0,2	6	0,281	13	0,184	4	0,003	0,1
Aegiceras corniculatum	0,104	3								
Rhizophora stylosa			0,033	1	0,351	16	0,718	16	0,0893	23,8
Xylocarpus granatum			0,067	2						
Bruguierra Gymnorhiza			2,6	83						
Total	4,193		0,3120		0,2178		0,4427		0,3750	

Mangroves in Leuweung Sancang Nature Reserve have a different dominance for each station. Station 1 is the highest dominance in the Sonneratia alba type with 4.04 m2/ha and its relative dominance is 96%. Station 2 is dominated by the Bruguierra gymnorhiza mangrove species which is 2.6 m2/ha with 83% relative dominance. Stations 3, 4 and 5 have mangrove species with the highest dominance being Sonneratia alba with, station 3 numbers 1.55 m^2/ha and relative dominance 71%, station 4 numbers 3,525 m^2/ha with relative dominance 80% and station 5 has a dominance of 2,854 m^2/ha with relative dominance of 76.1%.

The type of Sonneratia alba is often found in coastal locations protected from wave washouts, as well as in estuaries and around offshore islands and is intolerant of fresh water for a long time [10]. Another species that dominates besides Sonneratia alba is Bruguierra gymnorrhiza.

Bruguierra gymnorrhiza is often grown in soil areas with low salinity and dry and good aeration. This species is also usually located in substrates of mud, sand and peat soils, besides being found on the banks of rivers that are less affected by seawater [10]. Brugierra gymnorrhiza at station 2 is dominant because it can grow in areas with low salinity and dryness, as well as soils that have good aeration. This type is tolerant of protected areas as well as those that get direct sunlight. Brugierra gymnorrhiza also grows on the inland edge of mangroves, along ponds as well as tidal and brackish rivers, found on the shore only in case of erosion of the land in front of it. The substrate consists of mud, sand and sometimes black peat soil. Sometimes it is also found on the banks of rivers that are less affected by sea water, this is possible because the fruit is carried away by water currents or tidal waves [10].

3.5 Water Quality

Based on the results of water sample treatment, the results of observations of the chemical physical parameters of the waters are as shown in Table 5.

Table 5. Water Quality in the Mangrove Waters of Leuweung Sancang Nature Reserve

Station	Nitrate (mg/L)	Phospate (mg/L)	Acidity/ pH Degree	Dissolved Oxygen /Do (mg/L)	Salinity ($^o/_{oo}$)	Temperature (^{o}C)	Total Suspended Solids (mg/L)
1	0,05	0,03	6,8	7,4	36	30,4	20
2	0,04	0,55	6,9	11,9	23	29	55,4
3	0,03	0,42	6,8	7	31	29	56,7
4	0,03	1,96	6,4	9,9	33	27	40,2
5	0,04	0,55	6,6	4,4	33	28,5	32,6
Average	0.038± 0.008	0.702± 0.735	6.7±0.2	8.12±2.9	32±4.8	28.8± 1.2	41±15.5
Kepmen LH No. 51 Tahun 2004	0,002 – 0,008	0,015	7 – 8,5	>5	up to 34	28 – 32	80

3.5.1 Nutrient

Based on the results of laboratory analysis, data was obtained that the nitrate content ranged from 0.03 – 0.05 mg / L with an average of 0.038±0.008 mg / L. Nitrate calculation results have mostly exceeded the quality standards in Kepmen LH No. 51 of 2004 in marine life is 0.008 mg / L. Based on the concentration of nitrates obtained, the mangrove waters of the Leuweung Sancang Nature Reserve are included in oligotrophic waters with nitrate levels between 0 ± 1 mg / L [11].

The addition of nitrates has an impact on the development of stem diameter, height and number of stands for mangroves. Naturally, the concentration of nitrates in seawater is 0.002 – 0.008 mg / L based on Kepmen LH No. 51 of 2004 and is one of the compounds that functions in stimulating the growth of marine biomass so that it directly controls the development of primary production so that it is closely related to the fertility of a water. The high concentration of nitrates in the mangrove waters of the Leuweung Sancang Nature Reserve can be caused by a high influx of organic matter from land activities which can be in the form of land erosion, household waste input, agricultural waste in the form of fertilization residues and others that are carried directly into sea waters or through river flows. According to [11], almost all nitrates in marine waters are sourced from river flows produced by agricultural activities, anchorage, industry and household waste or population waste so as to produce nitrates and phosphates.

The ideal phosphate content according to Kepmen LH No 51. In 2004, it was 0.015 mg / L, while the phosphate calculation results ranged from 0.03 – 1.96 mg / L with an average of 0.702±0.735 mg / L, and the highest content was at station 4, namely 1.96 mg / L, while the lowest content at station 1 with 0.03 mg / L. Phosphate deficiency conditions can be harmful to marine life in the waters of the Leuweung Sancang Nature Reserve and can cause eutrophication. According to [11] that the maximum recommended level of phosphate for the waters that have been reported is 0.1 mg/l. Waters whose phosphate value is more than 0.1 mg/l as eutrophic waters so these waters often occur in phytoplankton blooming. Phosphate compounds in waters come from natural sources such as soil erosion, discharges from animals and weathering of plants. Concentrations increase with the influx of domestic, industrial and agricultural or plantation waste that contains a lot of phosphates, crushed organic matter and phosphate minerals [11].

3.5.2 Temperatures

The average temperature measurement results have changed from station 1 to station 5. Overall, the temperature conditions of the Leuweung Sancang Mangrove Reserve Waters range from 27 – 30.4^{o}C with an average of 28.8±1.2^{o}C. The highest temperature is station 1 with a temperature of 30.4^{o}C and the lowest temperature is found at station 4 of 27^{o}C. Based on Kepmen LH No.51 of 2004 that the ideal temperature for mangroves is 28 – 32^{o}C, so that the temperature at stations 1, 2, 3 and 5 is in accordance with the quality standards, while at station 4 the temperature values are below the quality standards. This value is a normal value for plankton development in tropical waters of 21-35°C (12). The temperature in these waters is still good for phytoplankton growth, although not at its optimum value. The optimum temperature range for the growth of marine phytoplankton is 20 - 30°C [12].

The low temperature at station 4 is due to sampling carried out in the morning so that the transparency of the incoming light is low, which results in a lower temperature at this station compared to other stations. This is in accordance with the statement [13] which states that light has a direct effect on temperature meaning that high transparency of light will generate heat and increase or deacrese the temperature.

3.5.3 Degree of Acidity (pH)

The results of taking station field data that have an acidity degree range from 6.4 – 6.9 with an average of 6.7±0.2. The highest station is station two with 6.9 and the lowest is station 4 with 6.4. Based on Kepmen LH No.51 of 2004, all stations are less than the seawater quality standards for marine life. The value of the degree of acidity does not indicate a significant difference between each of its stations. The high and low degree of acidity is influenced by its buffer capacity which is the content of salts in it. A large change in the degree of acidity indicates that the buffer system of the waters is disturbed, in other words, the degree of acidity of seawater is a parameter that is difficult to change [14].

This is in accordance with [14] statement in, that waters with an acidity degree of 5.5-6.5 and >8.5 include less productive waters. Strongly alkaline and highly acidic water conditions will endanger the survival of organisms because they will interfere with metabolic processes and respiration [11].

3.5.4 Salinity

Based on the results of field data analysis, salinity in the mangrove waters of the Leuweung Sancang Nature Reserve ranges from 23.7 – 36.3 $^{o}/_{oo}$ with an average of 31.68 $^{o}/_{oo}$. Stations that have high salinity, namely at station one with a salinity of 36 $^{o}/_{oo}$, while the lowest at station two with a salinity of 23 $^{o}/_{oo}$. Based on Kepmen LH No. 51 of 2004 the ideal salinity for mangroves is 0 $^{o}/_{oo}$ – 34 $^{o}/_{oo}$. Based on these standards, stations 2, 3, 4 and 5 are in accordance with quality standards, while for station 1 slightly exceeds the quality standard limit. Station 2 has the smallest salinity due to the presence of incoming fresh water so that salinity is smaller than other stations, while the highest salinity is found at station 1. According to the criteria, salinity in Indonesian waters generally ranges from 30-35 $^{o}/_{oo}$ [15], while for the open sea the salinity is >34 $^{o}/_{oo}$. High salinity can inhibit the growth of phytoplankton because according to the growth rate of phytoplankton is higher in waters with low salinity so that phytoplankton biomass tends to be high in low maternity waters [12]

Station 2 has the smallest salinity due to the presence of incoming fresh water so that salinity is smaller than other stations. According to [16] that estuary waters (estuaries) generally have very varied salinity and tend to be low at low tide because they get the influence of freshwater flow and tend to be high at high tide because they get the influence of seawater flow[16].

3.5.5 Dissolved Oxygen

Based on the results of the analysis of dissolved oxygen data ranging from 4.4 – 11.9 mg / L with an average of 8.12±2.9 mg / L. Based on Kepmen LH No. 51 of 2004 dissolved oxygen is ideal for marine life with a dissolved oxygen value of >5 mg / l. Based on the standards, stations 1, 2, 3 and 4 are in accordance with the quality standards, but station 5 is less than the seawater quality standards. According to [17] dissolved oxygen levels also fluctuate daily (diurnal) and seasonally, depending on the mixing and turbulence of water masses, photocystesis activity, respiration, and waste entering water bodies.

Station 5 has the lowest dissolved oxygen, which is 4.4 mg / L. Low dissolved oxygen at station 5 is influenced by the increase in organic matter entering the waters, in addition to other factors including temperature increase, salinity, respiration, the presence of layers above the water surface, easily oxidized compounds and atmospheric pressure, besides that the DO content in a water is closely related to the level of pollution, the type of waste and the amount of organic matter in a body of water [11].

3.5.6 Total Suspended Solid

Total suspended solids from 20 – 56.7 mg / L with an average of 41±15.5 mg / L. Based on Kepmen LH No.51 of 2004 for the ideal seawater quality standard for marine life in mangroves is 80 mg / L. This result is not in accordance with seawater quality standards, but the high value of dissolved solids will adversely affect the life of the mangrove biota itself so that, the high level of dissolved solids will block the entry of sunlight into the water, so that photosynthetic activity is blocked and oxygen produced in the water [18]. According to [19], the content of total suspended solids has a close relationship with the brightness of the waters. The presence of such suspended solids will block the penetration of light entering the waters so that the relationship between total suspended solids and brightness will show an inversely proportional relationship.

3.6 Plankton

3.6.1 Composition Phytoplankton

The composition of phytoplankton obtained during research in the mangrove waters of Leuweung Sancang Nature Reserve consists of the classes cyanophyceae, Bacillariophyceae, Euglenophyceae, Trebouxiophyceae, Chlorophyceae, Conjugatophyceae, Prymnesiophyceae and Dinophyceae. The percentage of phytoplankton composition at each station can be seen in the Figure 3.

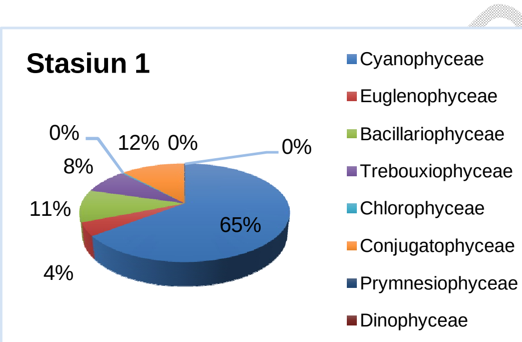


Figure A. Phytoplankton Stasion 1

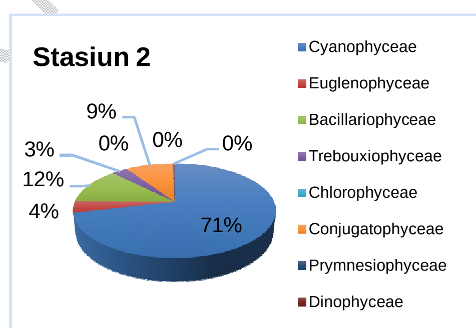


Figure B. Phytoplankton Stasion 2

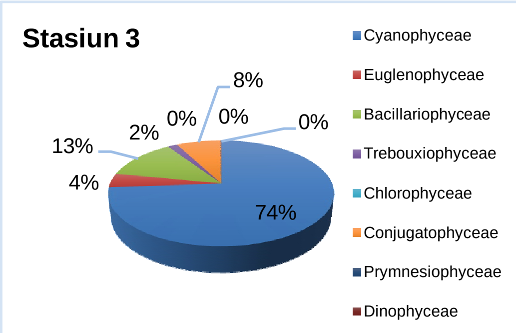


Figure C. Phytoplankton Stasion 3

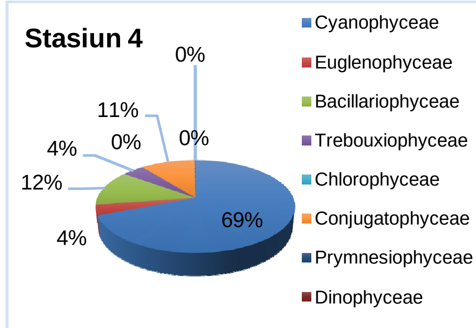


Figure D. Phytoplankton Stasion 4

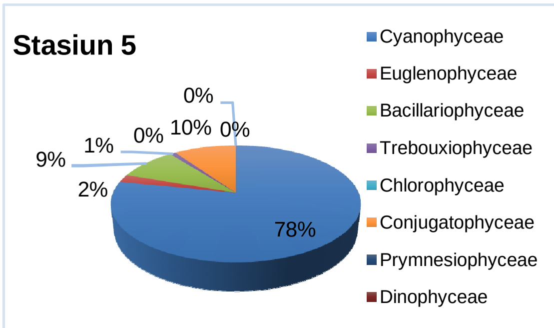


Figure E. Phytoplankton Stasion 5

Figure 3. Composition Phytoplankton Leuweung Sancang Nature Reservation

The composition of phytoplankton is related to the physical and chemical conditions of the waters because each type of phytoplankton has a different level of tolerance with its own habitat. Changes in the composition of phytoplankton in a body of water can describe changes in physical and chemical parameters and their interaction with the abiotic environment [20].

The results of the analysis of the abundance of phytoplankton compositions at all stations that dominated were the Cyanophyceae class with abundance at station 1, namely 835 ind/L, station 2, which was 977 ind/L, station 3 with a result of 1117 ind/L, then for station 4 with 767 ind/L and station 5 with 1151 ind/L. Cyanophyceae generally had high cell abundance at locations with low nutrient concentrations. Water locations with low nutrient concentrations are mostly found in high seas waters far from land influences characterized by clear or clean waters in both tropical and subtropical ocean waters [11].

3.6.2 Composition Zooplankton

The composition of zooplankton obtained during research in the mangrove waters of Leuweung Sancang Nature Reserve consists of the classes Branchiophoda, Malacostraca, Ostracoda, Gastropoda, Imbricatea, Eurotaria, Litostomatea, Spirotrichea, Oligotrichea, Oligohymenophorea, Karyorelictea, Actinopteri, and Thaliacea. The percentage of zooplankton composition at each research station can be seen in Figure 4.

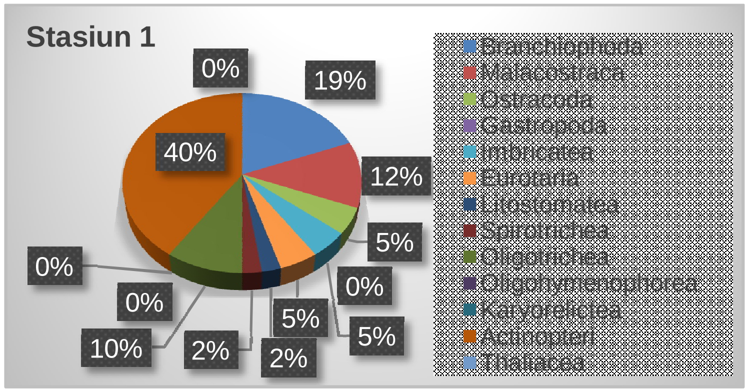


Figure A. Zooplankton Station 1

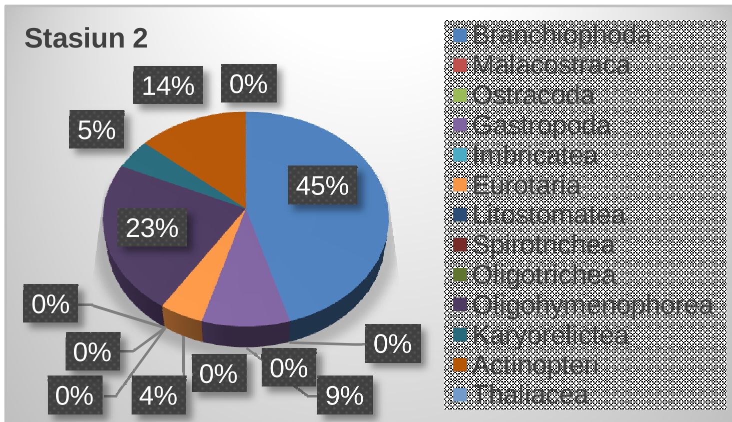


Figure B. Zooplankton Stasion 2

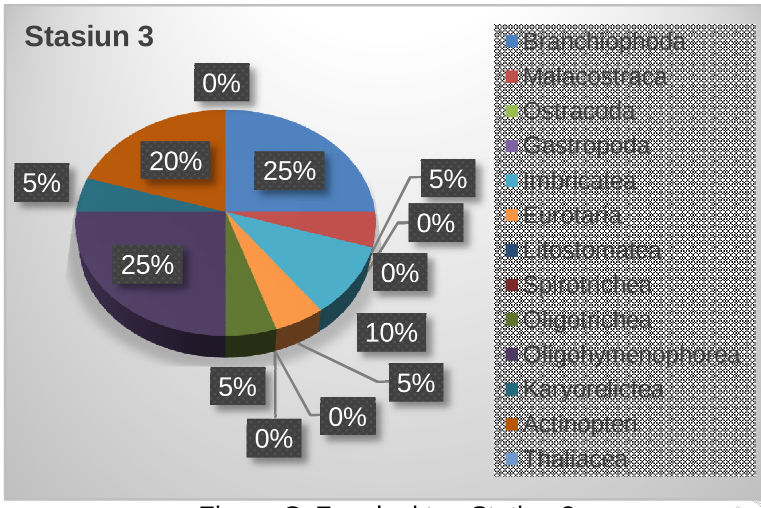


Figure C. Zooplankton Station 3

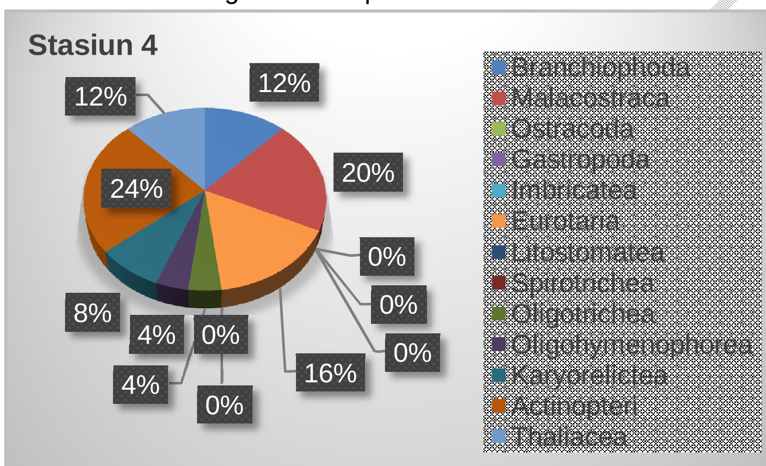


Figure D. Zooplankton Station 4

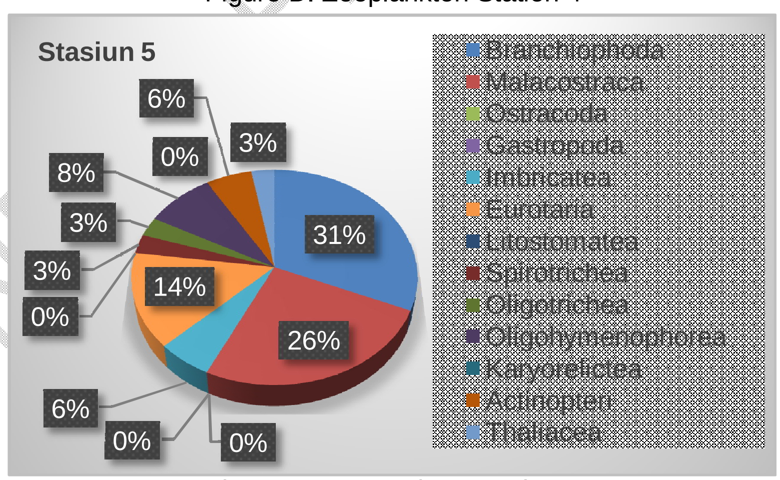


Figure E. Zooplankton Station 5

Figure 4. Composition Zooplankton Leuweung Sancang Nature Reservation

The results of the identification of zooplankton composition at station 1 consist of 14 genera, station 2 consists of 6 genera, station 3 consists of 9 genera, station 4 consists of 9 genera and station 5 consists of 15 genera. The Branchiophoda class is found at stations 2, 3 and 5 which are dominant of several other classes. According to [21], most zooplankton in the waters are dominated by the phylum Arthophoda.

3.6.3 Plankton Abundance

The abundance of plankton studied had varying values caused by differences in nitrate and phosphate concentrations at each station. Nitrates and phosphates are needed by phytoplankton so that the high low content of nitrates and phosphates in a water can affect the abundance of phytoplankton [22]. The abundance of phytoplankton can also be affected by mangroves because the destruction of mangroves can cause the loss of plankton habitat [1]. The abundance of plankton can be seen in Table 6.

Table 6. Plankton Abundance Leuweung Sancang Nature Reservation

No	**Plankton Name**	**Observation Station**				
		1	**2**	**3**	**4**	**5**
		Phytoplankton				
		Cyanophyceae				
1	*Spirulina* sp.	1418	1880	2358	1483	2528
2	*Tolyphothrix* sp.	5	8	5	3	10
3	*Gomphosphaeria* sp.	23	85	108	110	60
4	*Myrocystis* sp.	643	470	323	323	280
	Sub totals	2088	2443	2793	1918	2878
		Euglenophyceae				
5	*Euglena* sp.	140	133	165	100	80
	Sub total	140	133	165	100	80
		Bacillariophyceae				
6	*Diatome* sp.	75	0	225	78	55
7	*Skeletonema* sp.	95	0	0	10	173
8	*Isthmia* sp.	25	45	33	0	0
9	*Bacillaria* sp.	25	73	53	85	78
10	*Rhizosolenia* sp.	28	0	33	18	0
11	*Bacteriastrum* sp.	5	5	0	0	3
12	*Cyclotella* sp.	8	15	5	0	0
13	*Nitzshchia* sp.	0	3	5	10	0
14	*Pleurosygma* sp.	0	8	0	0	5
15	*Naviculla* sp.	0	13	3	5	3
16	*Chaetoceros* sp.	0	0	0	3	3
17	*Corethron* sp.	0	0	0	0	3
18	*Ampiphora* sp.	0	0	0	0	5
19	*Synedra* sp.	48	250	73	65	0
20	*Fragillaia* sp.	35	15	40	73	0
21	*Podocystis* sp.	3	0	8	0	8
	Sub totals	345	425	475	345	333
		Trebouxiophyceae				
22	*Oocystis* sp.	268	105	63	120	33
	Sub total	268	105	63	120	33
		Chlorophyceae				
23	*Scenedesmus* sp.	3	0	0	0	0
24	*Schroederia* sp.	10	0	0	0	0
	Sub total	13	0	0	0	0

No	Plankton Name	Observation Station				
		1	**2**	**3**	**4**	**5**
		Conjugatophyceae				
25	*Gonatozygon* sp.	50	65	110	63	120
26	*Pleurotaenium* sp.	103	0	10	0	0
27	*Cylindrocystis* sp.	148	193	140	230	235
28	*Tetmemorus* sp	78	33	20	0	0
29	*Cosmarium* sp.	0	3	0	0	0
30	*Netrium digistus*	0	18	8	0	0
	Sub total	378	310	288	293	355
		Prymnesiophyceae				
31	*Prymenesium* sp.	3	0	0	3	0
	Sub totals	3	0	0	3	0
		Dinophyceae				
32	*Noctilluca* sp.	0	10	3	0	0
	Sub totals	0	10	3	0	0
	Sub total Phytoplankton	**3233**	**3425**	**3785**	**2778**	**3678**
No.	**Plankton Name**	**Observation Station**				
		1	**2**	**3**	**4**	**5**
		Zooplankton				
		Branchiophoda				
	Nauplius sp.	18	25	13	8	23
	Metanauplius sp.	3	0	0	0	5
	Sub totals	20	25	13	8	28
		Malacostraca				
	Synopia sp.	3	0	0	0	13
	Anchialina sp.	0	0	0	0	5
	Euphausia sp.	3	0	0	0	3
	Pseudeuphausia sp.	3	0	0	5	0
	Parascelus sp.	5	0	3	8	3
	Sub totals	13	0	3	13	23
		Ostracoda				
	Cypris sp.	5	0	0	0	0
	Sub totals	5	0	0	0	0
		Gastropods				
	Cyclops sp.	0	5	0	0	0
	Sub totals	0	5	0	0	0
		Imbricatea				
	Euglypha sp.	5	0	5	0	5
	Sub totals	5	0	5	0	5
		Eurotaria				
	Brachiomus	3	0	3	3	8
	Diurella tenuis	3	0	0	0	0
	Monostyla	0	3	0	0	0

No	Plankton Name	Observation Station				
		1	**2**	**3**	**4**	**5**
	Pedalion mirum	0	0	0	8	5
	Sub totals	5	3	3	10	13
		Lithostomatea				
	Dileptus sp.	2,5	0	0	0	0
	Sub totals	2,5	0	0	0	0
		Spirotrichea				
	Stylonichia sp.	2,5	0	0	0	2,5
	Sub totals	2,5	0	0	0	2,5
		Oligotrichea				
	Tintinnidae sp.	10	0	2,5	2,5	2,5
	Sub totals	10	0	2,5	2,5	2,5
		Oligohymenophorea				
	Frontania sp	0	12,5	5	2,5	2,5
	Colipodium sp.	0	0	7,5	0	5
	Sub totals	0	12,5	12,5	2,5	7,5
		Karyorelictea				
	Loxodes sp	0	2,5	2,5	5	0
	Sub totals	0	2,5	2,5	5	0
		Actinopteri				
	Anguilulla sp.	42,5	7,5	10	15	5
	Sub totals	42,5	7,5	10	15	5
		Thaliacea				
	Salpa demotractica	0	0	0	7,5	2,5
	Sub totals	0	0	0	7,5	2,5
	Sub total zooplankton	105	55	50	63	88
	Total	**3338**	**3480**	**3835**	**2840**	**3765**

The zooplankton identified during the study had a relatively lower abundance compared to phytoplankton, although phytoplankton were consumed by zooplankton, but to achieve an abundant population took longer. The existence of lower zooplankton is a natural condition as a group of organisms that are at trophic levels above phytoplankton [23].

3.7 Biological Index

<u>3.6.1 Plankton Dominance Index</u>

The phytoplankton dominance index in the mangrove waters of the Leuweung Sancang Nature Reserve ranges from 0.25 – 0.49, while the zooplankton dominance index ranges from 0.12 – 0.29. The dominance index can be seen in Figure 5.

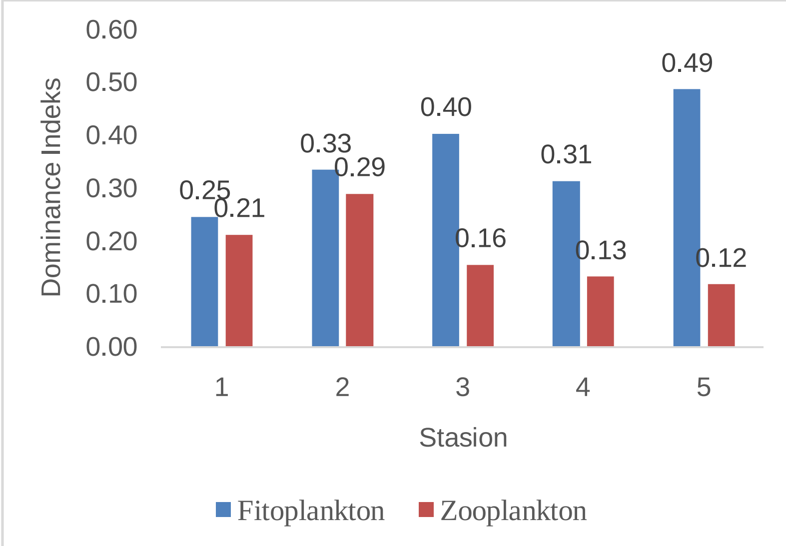


Figure 5.Plankton Dominance Index

The dominance index value ranges from 0.25 – 0.49 with the lowest dominance index value found at station 1 of 0.25, this indicates that the station as a whole station has phytoplankton dominance in low conditions. The dominance condition in zooplankton is also relatively low with dominance values ranging from 0.12 – 0.29. According to the statement of [24], that the range of 0 - 0.50 indicates that the area has low dominance, the dominance criterion from 0.50 - 0.75 indicates that the area has moderate dominance and for its dominance value 0.75 - 1 indicates the state of a place with high dominance.

The dominance at all stations on phytoplankton is the Cyanophyceae class with its abundance range 1918 – 2878 ind/L. Cyanophyceae are generally abundant at high nutrient concentrations, besides the high abundance of Cyanophyceae is related to the high degree of acidity [25]. The zooplankton that dominates stations 1 and 4 in the mangrove waters of the Leuweung Sancang Nature Reserve is the Actinopteri class, which is 42.5 ind/L and 15 ind/L, while at stations 2, 3 and 5 the dominating is the Branchiophoda class with an abundance of 25 ind/L, 13 ind/L and 28 ind/L.

<u>3.6.2 Plankton Diversity Index</u>

The plankton diversity index describes the level of plankton stability and a general estimate of the level of pollution that occurs [17]. The results of the calculation of the diversity index using the Simpson method can be seen in Figure 6.

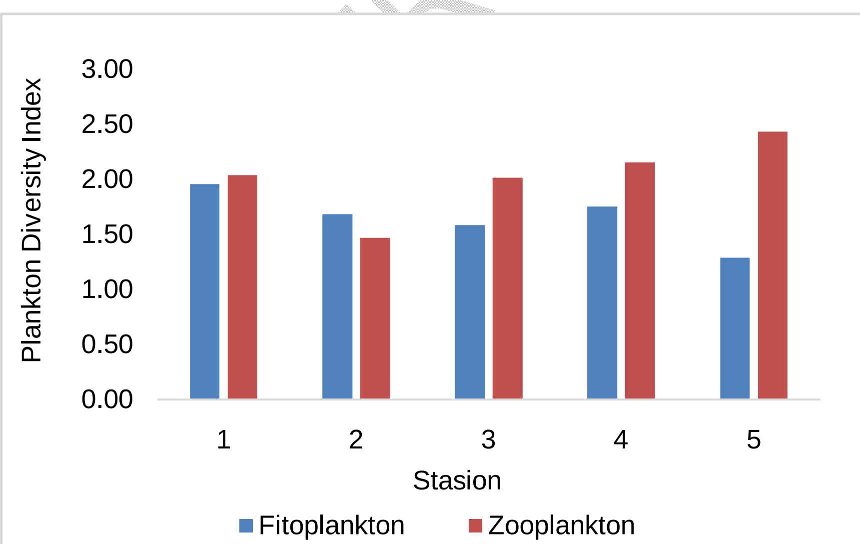


Figure 6. Plankton Diversity Index

The average value of the phytoplankton kaenkaragaman index ranges from 1.29 – 1.95. The lowest diversity index is at station 5 with 1.29 and the highest at station 1 with 1.95. This suggests that the phytoplankton diversity index is in the moderate category [26].

The value of the zooplankton diversity index ranges from 1.47 – 2.43. The value of the diversity index in the mangrove waters of the Leuweung Sancang Nature Reserve is in the moderate category. The lowest value at station 2 is 1.47 and the highest value is at station 5 with a value of 2.43. High species diversity indicates that a community has high complexity because the type interactions that occur within that community are very high. A community is said to have high species diversity if a community is composed by many types, on the contrary a community is said to have low species diversity if that community is composed by few types and if only a few are dominant [6].

3.6.3 Saprobic Index

The water saprobic index is measured using the type of plankton found because each type of plankton is a constituent of each specific saprobic group that will affect the saprobity value [27]. The results of plankton identification in the mangrove waters of the Leuweung Sancang Nature Reserve found 53 genera consisting of 21 polysaprobic genera, 5 α-mesosaprobic genus, 19 β-mesosaprobic genus and 8 oligosaprobic genus.

The results of the saprobic index calculation in the mangrove waters of the Leuweung Sancang Nature Reserve are known to be in mild to moderate polluted conditions (Table 7). This shows that the potential pollutant load is still within the pollution tolerance limit, so that the balance of the waters is still quite maintained.

Table 7. Saprobic Index Leuweung Sancang Nature Reservation

Station	Saprobic Index	Saprobity rate	Indication
1	1,10	β-mesosaprobic	Ringai to moderate pollution
2	1,13	β-mesosaprobic	Ringai to moderate pollution
3	1,10	β-mesosaprobic	Ringai to moderate pollution
4	1,12	β-mesosaprobic	Ringai to moderate pollution
5	1,10	β-mesosaprobic	Ringai to moderate pollution

Saprobity is measured by phytoplankton indicators, since each type of phytoplankton is a constituent of a certain group of saprobics that will affect the saprobity value [28]. The existence of saprobic organisms as an indicator of a body of water is also determined by the quality of the aquatic environment. Each type of saprobic organism will occupy certain waters and its existence is determined by the quality of the waters, namely the physical parameters of the waters [27].

Influential chemical physical parameters are nutrients in the aquatic environment that have a positive impact, but at some level can also cause negative impacts. The positive impact is an increase in phytoplankton production while the negative impact is a decrease in oxygen content in waters, as well as increasing the potential for the emergence and development of harmful phytoplankton types which are more commonly known as Harmful Algal Blooms or HAB [22]. Increasing nutrient levels in waters coupled with appropriate temperature and light, very slow water flow, and the presence of other supporting factors cause cyanophyta blooming in waters [29].

4. CONCLUSION

Based on the results of observations made in the mangrove waters of the Leuweung Sancang Nature Reserve, it can be concluded that:

1. The composition of plankton found 53 genera consisting of 30 phytoplankton genera 5 phylums and 6 classes, as well as 23 zooplankton genera consisting of 7 phylums and 15 classes. The abundance of plankton ranges from 2840 – 3835 ind / L which means that the abundance of plankton in the mangrove waters of the Leuweung Sancang Nature Reserve is in the moderate category, the dominance index of phytoplankton in the mangrove waters of the Leuweung Sancang Nature Reserve ranges from 0.25 - 0.49, while the zooplankton dominance index ranges from 0.12 - 0.29. the average value of the phytoplankton diversity index ranges from 1.29 – 1.95, while the zooplankton diversity index value ranges from 1.47 – 2.43 diversity index values in the mangrove waters of the Leuweung Sancang Nature Reserve in the medium category.

2. Based on the results of the saprobic index calculation in the mangrove waters of the Leuweung Sancang Nature Reserve, it is indicated that the waters of mild to moderate pollution, namely with a saprobic index value ranging from 1.10 – 1.13.
3. Based on the results of the analysis of saprobic index calculations in the mangrove waters of the Leuweung Sancang Nature Reserve, 53 genera consisting of 21 polysaprobic genera, 5 α-mesosaprobic genera, 19 β-mesosaprobic genera and 8 oligosaprobic genera with the most species are Spirulina with a total of 7732 ind / L.
4. The physical and chemical parameters of mangrove waters of the Leuweung Sancang Nature Reserve based on Kepmen LH No. 51 of 2004 for marine life of acidity, total solids, nitrates and phosphates suspended are not in accordance with seawater quality standards at all stations, while salinity, dissolved oxygen and temperature are not in accordance with seawater quality standards at several stations, namely station 1 with a salinity of 36.3 0/00 and station 4 with a temperature of 27^{o}C.

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