The abundance and diversity of plankton on peat swamps area Ogan Komering Ilir (OKI) Regency, South Sumatera

Helmizuryani1,2, R A Suwignyo3, Z Hanafiah3 and M Faizal3

1Doctoral Program of Sriwijaya University, JL. Padang Selasa No.524, Palembang, South Sumatera 30121, Indonesia
2Aquaculture Study Program, University of Muhammadiyah Palembang, JL. Jenderal Ahmad Yani 13 UluSeberanUlu II, Palembang, South Sumatera 30263, Indonesia
3Sriwijaya University, JL. Padang Selasa No.524, Palembang, South Sumatera 30121, Indonesia

Email: helmizuryani@gmail.com

Abstract. Peat swamp has very high conservation value, one of its plankton, because plankton is one of the determinants of water fertility. This research was conducted in January - April 2020. This study aims to determine the type and abundance of plankton in peat swamps in Ogan Komering Ilir Regency. Location is determinate by purposive sampling method based on environmental characteristics. Plankton sample identification was carried out at the Laboratory of the Faculty of Agriculture, Muhammadiyah University, Palembang. The results obtained were 86 species of plankton consisting of 4 classes of phytoplankton (Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae and 13 classes of Zooplankton (Dinoflagellata, Rotifera, Mastigophora, Granuloreticulosea, Appendicularia, Branchiopoda, Mysidacea, Tintinnidiidae, Sarcodina, Maxillopoda, Ostracoda and Monogononta). The abundance of OKI peat swamp plankton is classified as low ranging from 32.72 - 170.3 individuals/litter. The diversity index is moderate category, ranging from 1.49 - 2.56. The uniformity index ranges from 0.56 to 0.86. This indicates that between stations have uniformity, and the difference is not so striking. The dominance index ranges from 0.7 to 0.9 indicates that there are plankton species that dominate other types. Overall the types of plankton that dominate peat swamps are from the Bacillariophyceae class.

1. Introduction
Generally, the swamps in Ogan Komering Ilir (OKI) Regency are peat swamped swamps. Peat swamps are an essential ecosystem. Changes in land cover over peat swamps, especially the manufacture of drainage with the aim of artificial drainage, cause the condition of the ecosystem to be damaged. By making drainage for the drainage, peat, which is an organic material, is prone to burn and contributes to greenhouse emissions that cause climate change. The source of peat swamp water in OKI comes from rainwater and overflow from the surrounding water when the rainy season the surface of the swamp water will rise so that the swamp is rich in plankton and during the dry season the water level will drop and experience drought. Currently, peat swamps in OKI are widely used for human settlements and oil palm plantations, and this will affect the biota in the peat swamps in OKI.
The activity of oil palm plantations on peat swamp will affect the surrounding environment, including fertilization with organic fertilizer, will pollute the swamp water and cause a decrease in its fertility. Since ancient times the community's economy has relied heavily on fish reproduction in peat swamps for daily needs, and livelihoods. It is well known that peat swamp is an important ecosystem for fish habitat. The fertility of water can be seen from the presence of plankton organisms consisting of phytoplankton and zooplankton so that productivity can be seen from their waters. [1] stated that besides being a food producer, phytoplankton also played a role as an indicator in increasing water fertility. Phytoplankton as a food source starts from the seed phase of various aquatic organisms, such as fish, shrimp, seed, and shellfish seeds. There are 3 classes of phytoplankton genus found in the flooded swamp, namely the Bacillariophyceae, Cyanophyceae and Chlorophyceae classes [2].

In the food chain in the water including peat swamp plankton organisms are the primary productivity which will determine the level above that is in the form of various fish organisms, where phytoplankton will be eaten by zooplankton and fish subsequently zooplankton will be consumed by fish. This shows how important the existence of plankton organisms in water to the survival of other organisms such as fish, especially small fish that eat plankton. For this reason, it is necessary to conduct research on the types and abundance of plankton in the Ogan Komering Ilir (OKI) peat swamp in South Sumatra.

2. Research methods
2.1. Time and place
This research was carried out from January to April 2020 in the peat swamps of OKI Regency while observations and identification of plankton were carried out in the Biology Laboratory of the Faculty of Agriculture Muhammadiyah University, Palembang. Observation of water samples is carried out in situ in the OKI district peat swamps in the form of temperature, depth, brightness, pH, dissolved oxygen (DO) and ex situ in the UPT. Palembang City Environment and Sanitation Department Laboratory in the form of phosphate, nitrite. This research uses descriptive / survey methods, the data collected includes primary data obtained from water samples taken directly in the field and also analyzed in the laboratory while secondary data are obtained from the local government that is related to this study.

2.2. Sampling station
Sampling stations were determined by purposive sampling method by considering the characteristics and chemical, physical characteristics of peat swamp waters based on habitat typology so that four research stations were set with the following description (Figure 1):
Station 1: The peat dome area is mean the highest elevation point area of the peat hydrological unit (KHG).
Station 2: The area around the drainage of oil palm plantations
Station 3: Another Utilize Areas (APL), namely oil palm plantations, industrial timber plantations, human residence, and rice fields
Station 4: Lake area of Teloko is the lowest area so that all water accommodates for biology ecosystem
2.3. **Plankton sampling**

Plankton samples were taken 3 times with 3 replications at each station, to determine the sampling points carried out randomly or purposively. Plankton samples were taken using plankton net No. 25 with 50 litters of filtered water and put in 25 ml sample bottles and then given 2-3% formalin preservative as 2-3 drops. Each sample is labelled according to each station, and then the sample is stored and transported using a cool box. To measure water quality ex-situ, 250 ml water samples were taken at each station in a composite then taken to the laboratory to be observed, while for in situ measurements were carried out directly in the field.

2.4. **Plankton sample identification**

Observations of water samples were observed at the Biology Laboratory, Faculty of Agriculture, Muhammadiyah University, Palembang. Plankton bottle samples are shaken or shaken slowly so that the water samples inside do not accumulate in one section, then taken using 0.5 ml pipette drops with 2 repetitions, placed on glass objects, observations are made using A petri dish and observations are made in bringing a microscope using a 4x10 magnification then identified [3].

The tools used for this research are: Plankton Net, Falcon bottle, DO meter, pH meter, thermometer, GPS (Global Positioning System), Sedgwick raft counting cell (SRCC), Microscope, water sample bottles, spoon, fish surgery tools, measuring boards, boats, ropes, scales, petri dishes, fishing gear in the form of pedestals, pillars and gill nets. While the ingredients used are Fish, water samples, vegetation samples, 4% formalin, 10% alcohol, distilled water, tissue.

2.5. **Data analysis**

2.5.1. **Plankton abundance.** Calculation of plankton abundance is expressed in individuals / litters, to measure plankton abundance [4]:

\[
N = z \times \frac{x}{y} \times \frac{1}{v}
\]

Information about \( N \) is plankton abundance (Individual l^{-1}); \( z \) is individual found (Individual); \( x \) is volume of filtered water (ml); \( y \) is water volume observed (ml); and \( v \) is volume of filtered water (l).

Aquatic fertility is classified into 3 groups [5] i.e. <2000 cells l^{-1} (Oligotrophic fertility or infertile); 2000-15000 cells l^{-1} (Mesotrophic fertility or moderate fertility); and > 15000 cells l^{-1} (Eutrophic or fertile or fertility).
2.5.2. Plankton diversity index

\[ H = - \sum_{i=1}^{z} p_i \times \ln(p_i) \times N \]

Information about \( H' \) is plankton diversity index; \( p_i \) is the number of individuals of each type (\( p_i = \frac{n_i}{N} \)); \( n_i \) is the number of individuals of the \( i \)-th type; and \( N \) is the number of individuals of all types. With the criteria of diversity index values [6] i.e. \( H' < 1 \) (low diversity); \( H' 1 – 3 \) (moderate diversity); and \( H' > 3 \) (high diversity)

2.5.3. Plankton uniformity index. The value of uniformity index (E) ranges from 0-1 [7], as follows:

a) If the uniformity index (E) approaches 0, the uniformity between species is low, this reflects that the individual wealth of each species is very much different.

b) If the uniformity index (E) approaches the value of 1, then the uniformity between species is relatively evenly distributed, and the difference is not so striking

\[ E = \frac{H'}{\log S} \]

Information about E is uniformity index; \( H' \) is diversity; and \( S \) (Number of species).

2.5.4. Dominance index.

According to the criteria [7] i.e. if the C value is between 0-1, that is: If C approaches 0 (<0.5), then no species dominates and when C approaches 1 (> 0.5), a dominant species has found.

\[ C = \sum_{i=1}^{z} \frac{n_i}{N} \times \left( \frac{n_i}{N} \right)^2 \]

Information about C (Domination Index); \( N_i \) (Number of species of species); and \( N \) (Total number of species).

3. Results and discussion

3.1. Plankton abundance

The results showed the number of plankton found in the Ogan Komering Ilir peat swamp (OKI) 86 species consisting of 4 classes of phytoplankton (Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae) and 13 classes of Zooplankton (Dinoflagellata, Rotifera, Mastigophora, Granuloid, Apothorose, Granulic Aphrodisiac, Granulic Aphrodisiac, Granuloid, Aphrodisiculosis, Granuloid, Aphrodisiculosis, Granulics, Aphrodite), Tintinnidiidae, Sarcodina, Maxillopoda, Copepoda, Ostracoda and Monogononta), (table 1). The highest number of species from January to April in the class Bacillariophyceae, Chlorophyceae while other classes are not too much different. The results of this study are different from other results study that Ogan Komering Ilir illegal peat marsh peat swamp is the most species of the Cyanophyceae class [8].

From table 1, it can be seen that the percentage of zooplankton is lower than phytoplankton, due to plankton sampling conducted during the day, zooplankton is negative phototoxic to light so that zooplankton will enter the waters, this is supported by other results that the difference in the intensity of sunlight to the waters will affect the zooplankton vertical migration [9]. From the results of the plankton analysis that has been done as shown in table 1, that the function and role of plankton in OKI peat swamps is dominated by phytoplankton. Phytoplankton in waters can be said as primary producers, namely as the main food for aquatic organisms, especially fish, according to [8] primary producers in waters can be said to be natural food for primary consumers, especially fish larvae and zooplankton species.
Table 1. Percentage of plankton found during research in the OKI peat swamp

| Plankton Group     | Total Individual | Percentage |
|--------------------|------------------|------------|
| Cyanophyceae       | 49.17            | 8.78       |
| Chlorophyceae      | 117.42           | 20.96      |
| Bacillariophyceae  | 218.4            | 38.99      |
| Eulenophyceae      | 1.33             | 0.24       |
| Dinoflagellata     | 37.88            | 6.76       |
| Rotifera           | 50.25            | 8.97       |
| Mastigophora       | 17.92            | 3.20       |
| Granuloreticulosea | 38.95            | 6.95       |
| Appendicularia     | 2.65             | 0.47       |
| Branchiopoda       | 5.63             | 1.01       |
| Mysidacea          | 0.33             | 0.06       |
| Tintinnididae      | 7.93             | 1.42       |
| Sarcodina          | 8.65             | 1.54       |
| Maxillopoda        | 2.33             | 0.42       |
| Copepoda           | 0.66             | 0.12       |
| Ostracoda          | 0.33             | 0.06       |
| Monogononta        | 0.33             | 0.06       |
| **Total**          | **560.16**       | **100.00** |

Plankton abundance values during the study ranged from 119.1 to 225 individual l⁻¹, and the highest value was at station 4 and the lowest at station 1 (Figure 2). This plankton abundance value indicates that the OKI peat swamp is classified as oligotrophic (infertile). The high abundance of plankton at station 4, because station 4 is an open area so that sunlight can directly penetrate into the waters and one of the characteristics of fertile waters. Most species were found in the Bacillaryophyceae class, as much as 38.9%, an abundance of 85.7 individual l⁻¹ followed by the chlorophyceae class as much as 20.96%, an abundance of 39.2 individual l⁻¹, Rotifers as much as 8.97%, an abundance of 16.96 individual l⁻¹ and Cyanophyceae class as much as 8.78%, abundance of 14.5 individual l⁻¹ while the type of plankton from other classes has a percentage value that is not much different between classes where the percentage value ranges from 0.06 to 6.95%. The high value of the abundance of the Bacillaryophyceae class because the Bacillaryophyceae class is the most class living in the waters because it is resistant to extreme conditions, high reproductive power and very easy to adapt to the environment, [10] [11] stated that Bacillaryophyceae was very easy to adapt to the environment and it’s the plankton that can reproduce and produce well in nutrient-poor waters. The most commonly found species are *Rhizosolema* sp. and *Hemiaulushauckii* from the Bacillaryophyceae class. To carry out metabolic activities in the waters of the plankton group assisted with sunlight called the photosynthesis process which results in a nutritional compound for the life of plankton. According [12] that the high abundance of plankton in a waters because it can be well adapted to physical, chemical and biological parameters as well as sufficient organic substances.
Phytoplankton from the Bacillaryophyceae class can also live and adapt well to water pH 3.6 - 4.2 [13], pH at the research station supports plankton life ranging from 3.7 - 5. In addition, abundance of plankton populations in a waters caused the presence of nutrients that can be used as nutrients for plankton include phosphate and nitrate, the value of phosphate and nitrate at the research station also supports the life of plankton. Both of these nutrients are the main inorganic nutrients needed by plankton in breeding, while other organic and inorganic substances are needed in small amounts but affect the productivity and not as much as the amount of phosphate and nitrate [14].

3. 2. Plankton diversity Index (H')
Based on data analysis, the value of Plankton Diversity Index (H’) at each research station ranges from 1.9 to 2.3 (Figure 3), if this value is associated with the Shannon-Wiener Diversity Index [7] which is 1 <H’<3, the station is classified as a station with moderate diversity or moderate biota community. So the diversity index shown in Figure 3 shows that the OKI peat swamp is classified as moderate diversity. Diversity index value (H’) is strongly influenced by the number of species (species) of plankton with equitable distribution in the waters. This is consistent with [10][13], that if a community is said to have a high level of species diversity if there are so many species with the number of individuals of each species is relatively evenly distributed. Plankton population abundance in waters is strongly influenced by the presence of nutrients, where these nutrients will be utilized by plankton as nutrients including: phosphate and nitrate for breeding. High or low phosphate and nitrate content is what will affect the diversity of plankton in waters, especially with high values.

Figure 2. Graph of abundance of Bacillaryophyceae Class in OKI peat swamps

Figure 3. Graph of Plankton Diversity Index in OKI peat swamps
3.3. Uniformity index (E)
The purpose of the uniformity index is to see whether or not there is a balance in the waters of a species. The plankton uniformity index in OKI peat swamps ranges from 0.68 to 0.8 (Figure 4), the highest uniformity index is at station 1 and the lowest uniformity index is at station 3, the uniformity index for all stations is close to 1, overall the uniformity value of peat swamps OKI shows that between stations having uniform uniformity there is no striking and balanced difference. The similarity of species between stations is influenced by the same nutrient content between stations [3]. This means that the nutrient content of all stations in the OKI peat swamp is sufficient for the growth needs of plankton and all species are almost found in all stations, in other words at each station there is no competition both over place and competition over food.

![Figure 4. Plankton Uniformity Index in OKI peat swamps](image)

3.4. Dominance index (D)
The plankton dominance index value in the study location ranged from 0.78 to 0.83 (Figure 5).

![Figure 5. Plankton Dominance Index in the OKI peat swamp](image)

At all stations showing a dominance value (D) > 0.5, it can be interpreted that the structure of the plankton community in the OKI peat swamp has a dominance value of one or several species. The existence of a dominance index value is suspected due to the unequal distribution of species at each station; this result is by [10] study which states that a species is said to be dominant in a community as seen from the strength of the plankton species itself when compared to other species so that the species
can control water and there will be changes in a waters both the biotic community and the physical environment. Plankton that dominates is station 1, 2, 3 and station 4, which are Rhizolema sp., Hamiantushauckii and Nitzchiabrebissonii types (Table 2).

| Plankton Species       | Station 1 (I) | Station 2 (I) | Station 3 (I) | Station 4 (I) |
|------------------------|---------------|---------------|---------------|---------------|
| Rhizosolema sp.        | 3.55          | 10.11         | 7.89          | 5.87          |
| Hemiaulushauckii       | 3.33          | 18.11         | 6.11          | 3.11          |
| Nitzchiabrebissonii    | 1             | 0.44          | 2.55          | 5.22          |

3.5. Chemical physics parameters of OKI peat swamp waters

The results of water quality analysis in the form of temperature, depth, brightness, pH, dissolved oxygen (DO), phosphate and nitrite (Table 3). The results of temperature analysis on the OKI peat swamp at each station varied between 28 - 30.3 °C but the average is not much different, this is because at the time of measurement is not the same, different sampling locations and different weather at the time of measurement. This difference will affect the penetration of light into the water, and also the activity of heat exchange between air and water this is the same as the results of research [14] that the light entering the waters is influenced by shallow waters and cause heat to these waters. Water temperature will affect the organisms in which one of them is plankton, suitable temperature for plankton ranges from 22 - 30 °C [15].

The depth of the OKI peat swamp during the study ranged from 0.75 - 320 cm, the highest depth was found at station 4 and the lowest at station 3, this difference was caused by the topographic and bathymetric location of the swamp at the study site, besides that OKI peat swamp water was affected by the tide is rising and tides. Based on the height of inundation the depth of peat swamp is divided into 4 categories namely shallow categories (0-25 cm), medium categories (25-50 cm), deep categories (50-100 cm) and very deep categories (> 100 cm) [16], from this category the OKI peat swamp depth category can be determined which is included in the medium and deep categories.

The results of the analysis of the brightness parameters in the OKI peat swamp range from 21.9 to 63 cm, the brightness value differs from each station, one of which is due to the deposition of particles that cause turbidity. The lowest brightness at station 2 is due to the large number of mud particles entering through the flow of water from station 1, the peat dome carries the residual results of fertilization which causes the water to become turbid, this is in line with the explanation of [17] that in waters that affect the level of brightness is the time measurement, weather, suspended solids/turbidity and accuracy when taking measurements. With the large number of dissolved particles causing a reduction in the penetration of sunlight into water bodies, the brightness level is low, and the photosynthesis process is disrupted. According to [18] the appropriate brightness for the life of organisms in the waters is higher than 45 cm, from the above it can be said that the brightness values in the OKI peat swamp still support for living aquatic organisms.

Based on DO (Dissolved oxygen) analysis in OKI peat swamps, DO values range from 4.4 to 5.6 mg / l, this value is quite reasonable according to the environmental quality standard of 3.0. DO values between stations are not the same but the difference is not too far away, the highest dissolved oxygen is at station 3, if it is associated with the highest amount of plankton abundance it is not always the same as the highest DO value, in fact the highest abundance value is found at station 4. The high DO value is caused by station location which is an open area so that direct sunlight penetration penetrates the bottom of the waters and also the waters are overgrown by aquatic plants to carry out photosynthesis, in addition to diffusion from the atmosphere, the source of dissolved oxygen in water is sourced from the results of photosynthesis, wind and diffusion from the air [19].

The results of the analysis of water pH in the OKI peat swamp are relatively low, ranging from 3.7 to 5.0 and the condition of all stations is almost the same because the peat swamp is included in the category of acidic swamps and also has a low pH value, this is in accordance with the report of the
Resource Development Centre Water that the quality of peat swamp water has an extreme pH that ranges from 3.7 - 4.3. Another thing that causes low pH in peat swamps in OKI is the humic acid content caused by decomposition and decomposition of organic material from leaves, trees and wood around the swamp, as stated by [20] the low value of acidity in peat swamps due to influenced by the swamp characteristics that contain a lot of humus acid. From the results of the study of OKI peat swamp pH at Station 4 the pH reached 5 was possible because of the activity of peatland clearing into oil palm plantations, the opening of peatlands will change the land hydrology system by making drainage, this tends to increase pH [20]. The acidity level of waters that can support the life of organisms is around 5 – 9 [21], meaning that the OKI peat swamp is still able to support the life of aquatic organisms.

Table 3. Measurement of chemical physics water quality at observation station

| Parameter          | Observation Station |
|--------------------|---------------------|
|                    | 1  | 2  | 3  | 4  |
| Temperature (°C)   | 30,3 | 28,5 | 28 | 30 |
| Depth (m)          | 0,95 | 0,95 | 0,75 | 3,2 |
| Brightness (cm)    | 22,3 | 21,9 | 35 | 63 |
| DO (mgL-1)         | 4,5 | 4,4 | 5,6 | 4,5 |
| pH                 | 4,3 | 3,9 | 3,7 | 5,0 |
| Phosphate (mgL-1)  | 0,9 | 1,3 | 1,6 | 0,3 |
| Nitrite (mgL-1)    | 0,07 | 0,05 | 0,12 | 0,05 |

Nutrients that have an important role on the productivity of waters one of which is phosphate, phosphate is also a key to the fertility of the waters, while nitrate is nitrogen that is absorbed by plants transformed into protein further as a food source for animals [22]. Nitrate (NO3) is a major form of nitrogen and is also a supporting factor for phytoplankton as fish food in waters, according to [23] the activity of zooplankton in water will decompose nitrates so that the presence of nitrates in the waters will be reduced. The results of phosphate analysis in OKI peat swamps ranged from 0.3 to 1.3 mg l⁻¹, nitrate values ranged from 0.05 - 0.12 mg l⁻¹, the highest phosphate and nitrate values were at station 3, due to runoff water from the surroundings are from oil palm plantations, industrial plantations and rice fields of the population. The level of water fertility is divided into 4 groups, i.e.: a) 0.00 - 0.020 mg l⁻¹ (low fertility group), b) 0.021 - 0.050 mg l⁻¹ (moderate fertility group), c) 0.051 - 0.100 mg l⁻¹ (good fertility group) and d) 0.101 - 0.201 mg l⁻¹ (very good fertility group) [24], it means that the phosphate content value of the research shows that the OKI peat swamp is included in good fertility waters.

4. Conclusion
The observations of plankton in the OKI peat swamp consist of 86 species and 17 classes, the abundance is relatively low (less fertile) ranging from 119.1 - 225.0 individuals l⁻¹, the plankton diversity index of the medium category ranges from 1.9 to 2.2, Plankton uniformity index ranges from 0.68 to 0.80, this shows that between stations have uniform uniformity and the difference is not so striking, while the dominance index ranges from 0.78 to 0.83 indicates the presence of plankton species that dominate other types. Overall the types of plankton that dominate peat swamps are from the Bacillariophyceae class.

References
[1] Yuliana, Adiwilaga E M, Harris E, Pratiwi N T M 2012 The Relationship Between Phytoplankton Abundance and Physical-Chemical Parameters of Waters in Jakarta Bay. J. Aquatics 3 169
[2] Yusanti A and Widayatsih Q 2017 Phytoplankton Diversity in Flood Swamps in Medium Villages of Suak Tapeh Subdistrict, Banyuasin Regency (Proceedings of 2017 National Suboptimal Land Seminar, Palembang 19-20 October 2017)

[3] Davis C C 1995 The Marine and Freshwater Plankton (Michigan State Univ. Press. USA) p 562

[4] APHA 2005 Standard Methods for the Examination of Water and Waste Water 21th Edition (Publication Office Health Association Washington)

[5] Basmi J 2000 Planktonology. Plankton as an Indicator of Aquatic Quality (Bogor: Faculty of Fisheries and Marine Science) p 59

[6] Khotimah K 2013 Diversity of Phytoplankton in Lebak Deling Waters Ogan Komering Ilir Regency. J. Fish. 2 40

[7] Nugroho A 2006 Water Quality Bioindicators (Jakarta: Trisakti University)

[8] Sagala E P 2009 Potential of Plankton Community in Supporting Life in the Nektom Community in Waters rawa gambut, Lebak Jungkal in Kecamatan Pampangan, Ogan Komering Ilir (OKI) Regency, South Sumatra Province Res. J. Sains 12 53

[9] Kasry A and Fajri.NE2012 The quality of water in the Siak River estuary is reviewed from the Physico-Chemical parameter and planktonic organisms. Journal of Scale Excavation of powder

[10] Odum E P 1988 Fundamentals of Ecology Subtitles: Samingan, Third Edition (Yogyakarta: Gajah Mada University Press) p 824

[11] Sulistiyarto B 2013 Relationship between Saluang Fish (Rasbora argyrotaenia Blkr.) Abundance and Phytoplankton Population in Rungan River Floodplain Central Kalimantan. J. Trop. Animal Sci. 2 27

[12] Junaidi E, Hanafiah Z, Agustina S 2013 Plankton Community in Ogan River Waters Ogan Komong Ulu, South Sumatra (Proceedings of the Faculty of Mathematics and Natural Sciences, University of Lampung) p 265

[13] Yuliana and Astriyana 2012 Aquatic Productivity. (Jakarta: BumiAksara)

[14] Surbakti Y B 2009 Plankton Diversity Study in Lau Sitelu River Namorambe Village, Deli Serdang Regency (Thesis University of South Sumatra)

[15] Efriyeldi 2005 Macrozoobenthos Community Structure in Aquatic Surroundings Snapper in a Floating Cage. Periodic Fisheries 29 5

[16] Isnansetyo A and Kurniausty 1995 Phytoplankton and Zooplankton Culture Techniques (Yogyakarta: Kanisius)

[17] Bastoni 2018 Agro silvo fishery-based Integrated Peat Restoration Model (Wana-Mina-Tani) in OKI Regency, South Sumatra (Palembang Environment and Forestry Research and Development Centre)

[18] Effendi H 2003 Water Quality Study for Water Resources and Environmental Management (Yogyakarta: Kanisius) p 258

[19] Asmawi S 1985 Fish Ecology (Banjarbaru: Department of Education and Culture. Faculty of Fisheries University of Lambung Mangkurat)

[20] Yondra, Nelvia, Wawan 2017 Study of the Chemical Properties of Peatlands in Various Areas Landuse Chemical Study of Peat Landon Various Landuse. Agric Journal 29 103

[21] Purba J P 2014 Vertical Phosphate Profile in Bakuok Lake, Aursat Village, Tambang District, Kampar Regency, Riau Province (Pekanbaru: Riau University)

[22] Nurdin S 1999 Collection of Water Quality Sampling Training Materials in Public Waters. (Pekanbaru: Laboratory of Environmental Physiology Faculty of Fisheries and Marine Sciences Riau University) p 131

[23] Handayani S, Ridho R A, Bernas M S 2015 Plankton Diversity and Its Relationship with the Quality of the Canal waters in the National Park crossing Banyuasin Regency, South Sumatra J. Sci. Res. 17 137

[24] Nurachmi L 1999 Physics-Chemical Quality of the Dumai Oil Port Dredging Mud. Periodic Fisheries Terubuk 27 2
Acknowledgments
On this occasion the authors would like to thank the Chancellor, Dean of the Faculty of Agriculture, Colleague in Aquaculture Department University of Muhammadiyah Palembang and also Head of Natural Resource Department Sriwijaya University, who have given encouragement and support so that the completion of this research and all those who have helped in the completion of this research.