# TYPES AND DIVERSITY OF PHYTOPLANKTON IN DIFFERENT ZONES OF THE KOTO PANJANG RESERVOIR,KAMPAR, RIAU, INDONESIA

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## ABSTRACT

**A Study on the types and diversity of phytoplankton in the Koto Panjang Reservoir (Hydro-Electric Power Plant Reservoir), Kampar, Riau, Indonesia, have been conducted from May to October 2009. For water quality analysis, samples of water were collected every month from 6 stations on the reservoir which consisted of 1 station on the riverine zone, 2 stations on the transition waters, and 3 stations on the lacustrine zone. The components of the samples have been taken vertically as well as horizontally.**

**The diversity of the phytoplankton varies according to the zones, and there were 4 classes of phytoplankton which were consist of 6 types of Bacillariophyta, 5 types of Chlorophyta, 3 types of Cryssophyta, and 3 types of Cyaniphyta. Therefore, there were 17 types of phytoplankton have been recorded. The abundance of phytoplankton at the lacustrine zone were higher, compared to transition zone and riverine zone Such condition was estimated die to the higher of N and P ratio on the lacustrine zone compared to the transition and riverine zone. The analysis of index diversity, domination and similarity indicated that the condition of the reservoir still in suitable (balance) condition for phytoplankton without dominant species.**

**Key words: Koto Panjang reservoir, water quality, phytoplankton.**

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**Ecologically, the components of man made reservoir ecosystem consist of water, aquatic biotas and land, and their existannce basically depend on the water level, and reservoir also will affect the climatological condition and ecosystem balance on their environment. Reservoir, especially as the existance of the big volume of water, were usable for power plant that will produce electricity, as the irrigation for varied agricultures activities, for aquaculture to produce fish and other oaquatic animals, as a source water for citizen, for flood altering, etc. (Haeruman, 1999).**

**Koto Panjang reservoir (Kampar, Riau, Indonesia) were started to develop in 1992 and and completed in 1997. The area of the water surface were 12,400 ha and the elevation of the reservoir were 73.5-85.0 m. The main water supply came from Kampar River and Batang Mangat River. The two rivers system were collected the small streams from West Sumatera Province. Nowadays, the reservoir were also function as an important site for aquaculture activities especially for floating cage cultures.**

**The morphometric of the Koto Panjang Reservoir were dendritic. The reservoir were wide enough and according to the deep of the waters, the reservoir can be categorized as a deep reservoir. There were also so many small bays, and also had a long beeches, has a huge rain catching areas (Nastiti et.al. 2006). Based on the trophic status, reservoir can be classified as oligotrophic, mesotrophic, and eutropphic, the Koto Panjang Reservoir can be categorized as an eutrophic reservoir. Based on the physical, chemical, and the biological of the water in the reservoir, the areas of the reservoir can be divided into zone riverine, transition, and lacustrine zone (Thomt et. al. 1990). Therefore, the existence of the different zones, and also due to the aquaculture activities in the reservoir, will affected the diversities of phytoplankton on the different zones.**

**Lawrence et. al. 2000 stated that the availability of the nutrient, sun shine, mixing the water residence time, and temperature, were the main factors for the growth and the composition of the phytoplankton in the reservoir. The phytoplankton biomass depend on the grazing of the zooplankton. The organic nutrient, phosphor and nitrogen were the main factors for the primary productivity in the waters. Both of the organic nutrients especially phosphor, has an important role and can increase the productivity of the phytoplankton (primary productivity).**

**There were three different existences of the phosphor in the waters, i.e, organic phosphate (unsoluble), polyphosphate (partly soluble), and orthophosphate (soluble) (Saeni, 1991). If the phosphate in the waters higher than the normal need of the organisms, can caused the eutrophycation and also can kill many organisms in the waters (Ryding and Rast, 1989).**

## Materials and Methods

**The sampling of water have been taken at 5 stations, one station at the riverine zone, 2 stations at the transition zones, and 3 stations at the lacustrine zones. Three samplings of water from each stations have been conducted and the sample have been taken vertically, i.e. one from the surface zone, one from the middle zones, and one from the bottom waters. The water from each zone have been taken by using the water sampler, and the samples of the water were analyzed base on APHA (American Public Health Association, 1992). The parameter of water qualities such as temperature, transparency, pH, depth, DO, CO2, were directly measured in the fiels. The water qualities parameters such as sulphate, COD, BOD, nitrit, total N, ammonia, nitrate, and total phosphor, were analyzed at the water quality laboratorium.**

**The samples of phytoplankton at each stations have been sampled vertically by filtering the water for 0.5 l by using the plankton net (mesh size 25 µm). The samples of the water concentrated to 124 in volume, and keeped in water bottle sampler, and all samples added with 0.5% lugol. The identification of the plankton species were done based on the identification of Davis (1995).**

**The Abundance of the Phytoplankton**

**The Abundance of the Phytoplankton were counted based on the formulation of APHA (American Public Health Association, 1992):**

**N = h X A/B X C/D X 1/E**
**N = the abundance of the phytoplankton (cell/L)**
**n = mean of the total phytoplankton individu for each eye square area**
**A = the total area of the object glass ($mm^2$)**
**B = the total area of observed object glass ($mm^2$)**
**C = the total volume of filtered water (ml)**
**D = the volume of water observed under microscope (0.05)**
**E = the volume of filtered water samples (l)**

**Diversity Index, Domination, and Uniformity**

**Diversity Index of Shanon Winner Index (Odum, 1971) counted by the formula :**

**$H' = -\sum (ni/N)^2$ or $C = \sum(pi)^2$.**

**The Uniformity Index were counted by the formula of Odum (1971) :**

**E = H'/ln S.**
**H'= The Species Uniformity Index**
**C = The Species Domination Index**
**E = The Uniformity Index**
**ni = The number of individu for each species**
**N = The Total Individu for all species**
**S = The Number of Species**

## Results and Discussion

### The Species and Abundanee of Phytoplanktons.

**There were 4 classes of phytoplankton collected from the lake, consist of : Bacillariophyta (5 species), Chlorophyta (5 species), Crysophyta (3 species), and Cyanophyta (3 species). Therefore, 17 species of phytoplankton have been collected along the sampling period (6 months).**

**The abundance of the phytoplankon, at the riverine zones, transition zones, and at the lacustrine zones of the lake was variated along the sampling periods (Tabel 1).**

**Tabel 1. The Abundance of Phytoplankton (cell/l) at the different zones of the Koto Panjang Reservoir along the sampling periods.**

| Sampling Month | ZONE | | |
|---|---|---|---|
| | Riverine | Transition | Lacustrine |
| May | 4.352 | 5.945 | 7.006 |
| June | 4.246 | 6.157 | 7.042 |
| July | 5.096 | 6.900 | 7.820 |
| August | 6.051 | 5.414 | 7.502 |
| September | 6.051 | 5.733 | 7.502 |
| October | 4.989 | 5.468 | 6.369 |
| Total | 30.785 | 35.617 | 43.241 |
| Means | 5.131 | 5.936 | 7.207 |

**The lowest abundance of the phytoplankton were 4.246/l, and it was at the riverine zone and the month of the sampling period was on June. The highest abundance of the phytoplankton were at the lacustrine zone, 7.820 cell/l, and collected on August. The different in the abundance of phytoplankton at the two zones, due to the differences of Nitrogen and Fosfor at the two zones. The water sampling indicated that theNitrogen and Fosfor at the lacustrine zone were higher than that of the riverine zone (1.397 mg/l and 0.132 m/l at the riverine zone; 1.397 mg/l and 0.126 mg/l). The condition were supported by the research that were conducted by Lawrence et.al. (2000).**

### Diversity, Domination and Uniformity of the Phytoplankton.

**The Diversity Index of the phytoplankton in the Koto Panjang Reservoir in the different zones along the research period, were variated from month to month (Tabel 2.).**

**Tabel 2. The Means Index of the Diversity of the Phytoplankton at the Different Zones in the Koto Panjang Reservoir along the Research Period.**

| Observation Month | ZONE | | |
|---|---|---|---|
| | Riverine | Transition | Lacustrine |
| May | 2.59 | 2.58 | 2.54 |
| June | 2.62 | 2.69 | 2.55 |
| July | 2.66 | 2.68 | 2.49 |
| August | 2.70 | 2.64 | 2.63 |
| September | 2.65 | 2.75 | 2.49 |
| October | 2.66 | 2.69 | 2.77 |
| Total | 15.88 | 16.63 | 15.47 |
| Means | 2.65 | 2.67 | 2.58 |

**The lowest Diversity Index of the phytoplankton were on the lacustrine zone, and the highest of the Diversity Index were on the riverine zone. The condition were correlated with the decrease in the abundance of the phytoplankton (Weber, 1973). Such condition also correlated with the condition of the reservoir that was polluted.**

**The Domination Index of the phytoplankton in the reservoir at each zones, variated from month to month (Tabel 3.).**

**Tabel 3. The Means Domination Index of the Phytoplankton in Different Zone of the Koto Panjang Reservoir along the Research Period.**

| Observation Month | ZONE | | |
|---|---|---|---|
| | Riverine | Transition | Lacustrine |
| May | 0.20 | 0.21 | 0.20 |
| June | 0.19 | 0.21 | 0.23 |
| July | 0.19 | 0.21 | 0.21 |
| August | 0.19 | 0.21 | 0.19 |
| September | 0.19 | 0.19 | 0.18 |
| October | 0.19 | 0.20 | 0.17 |
| Total | 1.15 | 1.23 | 1.18 |
| Means | 0.19 | 0.21 | 0.20 |

**The lowest Domination Index of the Phytoplankton were on the lacustrine zone, and happened on the October, and the highest Domination Index also happened on the same zone on July. The Domination Index of the phytoplankton were 0-1 (Weber, 1973), and Weber also stated if the Domination Index next to 0 (≤0.5) it means that there were no species that dominated the phytoplankton in the waters, contrary if the Domination Index almost reached 1 (≥0.5) indicated that there were the species of phytoplankton dominant on the waters. Based on the value of the**

**Domination index on the Kota Panjang Reservoir, it was concluded that there were no species of phytoplankton dominant on the waters along the research period.**

**The means value of the Uniformity index of the phytoplankton in Koto Panjang Reservoir (Tabel 4) indicated that there were the fluctuation of the value from month to month at each zones (0.85-0,98). The differences between the Unifomity Index of the phytoplankton in the Koto Panjang Reservoir were due to the differences in the species and abundance of the phytoplankton in each zones (Tabel.4)**

**Tabel 4. The Mean Values of the Uniformity Index of the Phytoplankton in the Different Zones of the Koto Panjang Reservoir, along the Research Period.**

| Observation Month | ZONE | | |
|---|---|---|---|
| | Riverine | Transition | Lacustrine |
| May | 0.90 | 0.86 | 0.89 |
| June | 0.92 | 0.90 | 0.85 |
| July | 0.91 | 0.91 | 0.89 |
| August | 0.90 | 0.87 | 0.92 |
| September | 0.92 | 0.89 | 0.98 |
| October | 0.91 | 0.90 | 0.94 |
| Total | 5.46 | 5.33 | 5.35 |
| Means | 0.91 | 0.89 | 0.89 |

**The normal value of the Uniformity Index were 0-1 (Wyne, 1985 in Fahrul 2007). If the value of the Uniformity Index were ±1, the uniformity of the organisms in the environment were at the normal condition. It was also indicated that the condition of the waters in the Koto Panjang Reservoir were in good condition for the phytoplankton and other organisms.**

## Conclusion

**The result of the research indicated that there were differences in the abundance of the phytoplankton between lacustrine zone, transition zone, and riverine zone. The value of the Diversity index, Domination index, and the Uniformity Index, at each zones, indicated that there were negative pressure on the community structure of phytoplankton. There were no dominant species of phytoplankon, and community of phytoplankton on the reservoir still in balanced, and also there were no competition for food and environment. But there were a little pressure on the reservoir that come from the activities around the reservoir as well as from the activities of cage culture of fish in the reservoir.**

## References


**APHA (American Public Health Asociation). 1992. Standard Method for The Examination of Water and Wastewater. American Public Health Association. Washington D. C.. 874p.**

**Davis, C. C. 1955. The Marine and Freshwater Plankton. Michigan State University Press.**

**Fachrul, M. F. 2007. Metode Sampling Bioekologi. Pt. Bumi Aksara. Jakarta. 163 halaman.**

**Haeruman, H. 1999. Kebijakan Pengelolaan Danau dan Waduk Dhinjau dari Aspek Tata Ruang. National Seminar dan Workshop on Lake and Reservoir Management and Utilization. Bogor 30 November 1999. PPLH-IPB Bogor.**

**Jorgensen, S. E. and R.a, Vollenweider. 1988. Guidelines of lake Management. Vol. 1. Principle of Lake Management. International lake Management Committee, United Nation Environment.**

**Lawrence, L., M. Bormans, R. Oliver., G. Ranson., B. Sherman., P.Ford and N. Schofield. 2000. Factors Controlling Algae Growth and Composition in Reservoir : report of Reservoir Manager Workshop. Coperative Research Centre for Freshwater Ecolgy.**

**Nastiti, A. S., D.W.H. Tjahjo, K. Purnomo., H. Satria., A. Nurfiarini., A. Suryandari., N. Widarmanto., Y. Sugiyanty., A. Warsa., dan M. Nasir. 2006. Rehabilitasi Populasi Ikan di Danau Teluk (Jambi) dan Waduk Koto Panjang (Riau). Pusat Riset Perikanan Tangkap Badan Riset Kelautan dan Perikanan. DKP. Jakarta.**

**Odum, E.P. 1971. Fundamental of ecology Third Edition. Saunders. Philadelphia.574 p.**

**PLN (Perusahaan Listrik Negara). 2002. PLTA Koto Panjang. Pekanbaru.**

**Ryding S. O. and W. Rast. 1989. The Control of Eutrophication of Lakes and Reservoir. The Porthenon. Publishing Group. New Jersey.**

**Saeni, M. S. 1989. Kimia lingkungan. Departemen P dan K. Dirjen Pendidikan Tinggi. PAU Ilmu Hayat. IPB. 151 halaman.**

**Weber, C. I. I973. Biological Field and Laboratory Methods for Measuring the Quality of Surface Water and effluents.**