Nitrate and phosphate dynamics of phytoplankton abundance in Kanceng River, Sepuluh, Bangkalan, East Java, Indonesia

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Abstract. The river is a lotic ecosystem with biological, ecological and economical functions essential for human life. Kanceng River is one of the rivers in Bangkalan, where the whiteleg shrimp aquaculture activities are conducted intensively. Thus, it may bring nutrients needed for the survival of the mangrove population as well as the possibility of pollution from inorganic material. Nutrients are substances needed by organisms for the shrimp metabolism. Nutrients in the water affect phytoplankton, which has an important role in the aquatic ecosystem. This research aimed to assess whether the nitrate and phosphate levels affect the phytoplankton abundance in Kanceng River, as well as its correlation to the water quality. The results showed that the trophic status of Kanceng Rivers was included in eutrophic waters with phytoplankton abundance of >15,000 cells/ml. The dominant phytoplankton includes Cyanophyceae (Microcystis, Chlorella) and Eustigmatophyceae (Nannochloropsis) classes.

1. Introduction
The river is a lotic ecosystem that has a biological, ecological and economic role that is very important for humans. The river is one of the largest sources of water suppliers for humans [1]. Based on the survey results, most along the Kanceng River there are pond areas, namely vaname shrimp cultivation that uses intensive cultivation systems so that the potential to produce inorganic waste, especially nitrate and phosphate which is also a nutrient, where nitrates and phosphates are substances that are needed and affect the process and development phytoplankton, namely nitrate and phosphate nutrients. Phosphate and nitrate are needed in the process and development of living organisms such as phytoplankton. The high and low abundance of phytoplankton in water depends on nutrient content in water such as phosphate and nitrate [2]. According to [3] that phosphate and nitrate are very important for the growth and metabolism of phytoplankton which are indicators to evaluate the quality and level of water fertility.

2. Material and Methods
2.1 Research Location
Kanceng river, Maneron Village, Sepulu District, Bangkalan District and Microbiology Laboratory, Faculty of Fisheries and Marine Airlangga University.

2.2 Data Collecting Method
Plankton sampling was carried out directly in river waters using net plankton with a mesh size of 50 µ [4]. Measurement of nitrate and phosphate concentrations was done by taking water samples at a depth of 50 cm below the surface of the water using a sample bottle and analysis in the laboratory using the
Brucine Sulfate and Stannous Chloride methods [5], [6]. Nitrate and phosphate concentrations were expressed in mg / L units.

Supporting parameter measurements are carried out directly at each sampling station. Water quality parameters measured are physical and chemical parameters including temperature, brightness, depth, currents, salinity, dissolved oxygen (DO) and pH.

3. Result and Discussion
The results of water quality measurements at the Kanceng river at each station presented in Table 1.

| Tabel 1. Water Quality in Kanceng River |
|----------------------------------------|
| Stasiun | I | II | III |
| Week | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| NO₃ (mg/L) | 1.76 | 1.28 | 2.14 | 1.42 | 1.82 | 2.82 | 1.69 | 2.51 |
| NH₄ (mg/L) | 1.42 | 1.39 | 1.63 | 1.73 | 1.53 | 1.81 | 1.86 | 1.82 |
| PO₄ (mg/L) | 0.05 | 0.05 | 0.11 | 0.11 | 0.09 | 0.23 | 0.19 | 0.21 |
| DO (mg/L) | 7.31 | 7.25 | 5.49 | 3.75 | 2.70 | 3.35 | 3.70 | 2.12 |
| BOD (mg/L) | 4.27 | 4.21 | 6.19 | 6.87 | 5.02 | 8.53 | 9.11 | 7.92 |
| COD (mg/L) | 11.33 | 10.77 | 9.17 | 20.41 | 22.46 | 18.53 | 25.69 | 27.32 |
| Salinity (ppt) | 19 | 16 | 14 | 10 | 21 | 14 | 13 | 10 |
| Temperature (°C) | 27.7 | 27.2 | 26.6 | 27.3 | 28.6 | 26.8 | 27.5 |
| pH | 5.7 | 7.2 | 4.8 | 6.9 | 7.2 | 4.6 | 7.0 | 5.6 |
| Brightness (cm) | 65 | 70 | 45 | 100 | 90 | 60 | 90 | 70 |
| Depth (cm) | 130 | 160 | 100 | 130 | 120 | 90 | 120 | 100 |
| Currents (m/s) | 0.25 | 0.25 | 0.1 | 0.25 | 0.25 | 0.1 | 0.25 | 0.25 |

Nitrate concentrations at the station I ranged from 1.12 to 1.76 mg / L, station II ranged from 1.42 to 2.14 mg / L, and station III ranged from 1.69 to 2.82 mg / L. While the phosphate concentration at the station I ranged from 0.03 to 0.05 mg / L, station II ranged from 0.09 to 0.11 mg / L, and station III ranged from 0.19 to 0.23 mg / L. Nitrate and phosphate levels are still good for phytoplankton growth. This is in accordance with [7] which stated that the optimum nitrate value for phytoplankton growth ranged from 0.9 to 3.5 mg / L. According to [8] which states that the optimal phosphate value for phytoplankton growth is 0.09-1.80 mg / L.

Nitrate and phosphate levels are associated with dissolved oxygen (DO) in waters that affect the work of nitrifying bacteria. Nitrifying bacteria in the process of nitrification by converting organic material into inorganic materials requires optimal oxygen. Graphs of fluctuations in nitrate and phosphate levels in the Kanceng River presented in Figure 1.
DO levels at the station I ranged from 7.25 to 7.82 mg/L with nitrate levels ranging from 1.12 to 1.76 mg/L and phosphate ranged from 0.03 to 0.05 mg/L. DO levels are still good for phytoplankton life. According to [9] that the concentration of dissolved oxygen which is good for plankton life is > 3 mg/L. DO levels at the station I can support the process of formation of nitrates and phosphates in water. So that nitrate and phosphate nutrients are widely used by phytoplankton for growth. In addition, the location of the station I which is near the estuary is easily tidal. As a result, there is a change in the volume of water from the estuary towards the sea which causes nutrients to be carried by the water, which causes nitrate and phosphate concentrations at the station I to be low. DO levels at station II ranged from 2.70 to 5.49 mg/L with nitrate levels ranging from 1.42 to 2.14 mg/L and phosphate ranged from 0.09 to 0.11 mg/L. DO levels are still good for phytoplankton life in these waters. Nitrate and phosphate levels at station II located after the location of shrimp farming ponds that have the potential to receive organic waste discharges in the form of leftover food, dead organisms, faeces that cause the addition of organic particles so that the brightness of the waters becomes somewhat turbid causing an accumulation of organic matter and contribute to the value of nitrates in station II. pH at station II is 4.8-7.2 which is classified as acidic so that it can affect phytoplankton metabolism in waters. According to [10] that the optimal pH value for phytoplankton growth is 7 - 8.5. Graphs of DO fluctuations, temperature, pH and salinity in the Kanceng River presented in Figure 2.
Figure 2. Temperature, pH and salinity fluctuations in the Kanceng River

DO levels at station III ranged from 2.12 to 3.70 mg/L with nitrate levels ranging from 1.69 to 2.82 mg/L and phosphate ranged from 0.19 to 0.23 mg/L. DO levels are still good for phytoplankton life. The level of dissolved oxygen that is good for plankton life is > 3 mg/L [9]. DO levels < 3 mg/L can be caused by increased activity of microorganisms in breaking down organic matter into inorganic materials. pH values ranging from 4.6-7.0, which are classified as acidic, can be caused by an increase in CO₂ content from the respiration activity of deep microorganisms. Nitrate and phosphate levels in station III can be caused by the location of the station which is after the settlement of the population that receives input of organic material from the domestic dosage of the population. Nitrate sources at station III are thought to come from bathroom waste disposal containing ammonia and urea to increase nitrate levels. While phosphate levels can come from weathering rocks around rivers, soil erosion that enters the water and dead organisms. Also, there is a small portion of detergent waste from the settlement, but the number of residents at station III is not too dense.

The results of identification of phytoplankton in the River Kanceng found 18 genus phytoplankton consisting of six classes including Bacillariophyceae (three genera), Chlorophyceae (three genera), Cyanophyceae (three genera), Dinophyceae (six genera), Euglenophyceae (three genera), Chlorophyceae (three genera), Cyanophyceae (three genera), Dinophyceae (six genera), Euglenophyceae (three genera), Elorigyceae (three genera). The abundance of phytoplankton at each station presented in table 2.

Table 2. Abundance of phytoplankton in the Kanceng River (x 10^2 cells / ml)

| Station | Station I | Station II | Station III |
|---------|-----------|------------|-------------|
| Week -  | 1 2 3 1 2 3 | 1 2 3 1 2 3 | 1 2 3 1 2 3 |
| Bacillariophyceae | 25 0 0 25 0 350 0 0 0 | | |
| Chlorophyceae | 125 1300 750 475 575 1150 225 950 725 | | |
| Cyanophyceae | 2075 8825 5800 1125 4300 8800 1175 1550 5725 | | |
| Dinophyceae | 0 25 75 50 300 225 100 75 100 | | |
| Euglenophyceae | 75 25 75 25 75 0 25 0 | | |
| Eustigmatophyceae | 0 750 825 25 400 1975 275 875 3600 | | |

Figure 3. Fitoplankton abundance station I
Based on the research results of phytoplankton class that dominate in Kanceng river, they are Cyanophyceae class of Microcystis type, Chlorophyceae class of Chlorella type, and Eustigmatophyceae class of Nannochloropsis type. [11] states that Microcystis plankton species grow quickly under certain conditions, namely in the dry season and high nutrient content in the waters. This class of phytoplankton can increase nutrient enrichment in waters so that there is an increase in productivity with an ecological improvement and an increase in water dissolved oxygen content [12].

Eustigmatophyceae is phytoplankton that is able to produce pigments (zeaxanthin and astaxanthin) and Poly Unsaturated Fatty Acid (PUFA). The element nitrogen in waters is a very important nutrient for phytoplankton class Eustigmatophyceae [13].

Based on the abundance of phytoplankton in the Kanceng river, it can be classified into aquatic trophic status based on the abundance of phytoplankton in water. The abundance of phytoplankton in the Kanceng river in stations I, II and III are classified into eutrophic waters, which are waters that have a high fertility rate with phytoplankton abundance > 15,000 cells / ml. According [14] states that trophic status based on phytoplankton abundance there are three kinds, namely oligotrophic waters are waters that have low fertility levels with phytoplankton abundance ranging from 0-2,000 cells / ml, mesotrophic waters are waters that have moderate fertility levels with phytoplankton abundance ranges from 2,000-15,000 cells / ml, and eutrophic waters are waters that have high fertility levels with an abundance of phytoplankton > 15,000 cells / ml. The weather conditions during the study were sunny and there was no rain because the study was conducted during the dry season.
4. Conclusion
Nitrate concentrations in the Kanceng river ranged from 1.12 to 2.82 mg/L. Whereas the concentration of phosphate in the Kanceng river ranged from 0.03 to 0.23 mg/L. The trophic status of waters in the Kanceng river based on the abundance of phytoplankton, nitrates and phosphates is included in eutrophic waters but is not polluting.

5. References
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