Chlorophyll a concentration of Phytoplankton in Estuary Mangrove Kurau, Bangka Tengah, Indonesia

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Abstract. Chlorophyll a is bound within microalgae and other phytoplankton found in surface seawater. Chlorophyll is an important biochemical component in the molecular apparatus of microalgae that is responsible for photosynthesis. Photosynthesis is the process whereby phytoplankton use sunlight energy and dissolved nutrients to convert inorganic carbon to organic compounds and releasing oxygen. The objective of this research was to analyze chlorophyll a concentration of phytoplankton in estuary mangrove area in Kurau, Bangka Tengah, Indonesia. The research was carried out in estuary area that is mangrove Kurau, Bangka Tengah, Indonesia. Chlorophyll a concentration was determined using spectrophotometer method. The chlorophyll a concentration and sea water parameters were recorded for all stations. The area was divided into four research sites. Based on the data, chlorophyll a concentrations were between 0.00587 mg/L – 0.00117 mg/L. It was considered low rate chlorophyll a concentration since lack of light penetration in the research area.

1. Introduction

The sampling area in this research is estuary and most of it covers by mangrove so called Mangrove Kurau, Bangka Belitung Province, Indonesia. The influx of the water into the estuary mangrove Kurau is generally get influence from Kurau River, Munjang Stream and classified by daily tidal water. Mangrove Kurau is approximately 213 ha area width and facing The Natuna Sea. The research site is a semi enclosed coastal body of water, which has a loose connection with open sea. This aquatic system is measurably diluted with freshwater derived from land drainage as well. The Kurau estuary water is mixed by the water passing from Kurau Rivers and Munjang stream. This area has some function as a feeding ground, fishing ground, and spawning ground for some species of fish and prawn. The area around the mangrove is a fisherman village so that the water conditions will also affect the catch. Further, the pattern of dilution in this aquatic area is influenced by freshwater volume, tidal range and rates of evaporation of the water in the Mangrove Kurau estuary. The area is characterized by distinct gradients of physical and chemical components of water parameters since tempering of both different water bodies so called estuary [1].

Estuaries principally defined as a form transition zones or buffering capacity of ecosystems of the significant filter zones between freshwater and marine environment. Hence, this area are incredibly
constant change ecosystem, where all aspect of water such as temperature, water clarity, depth, salinity and water current will alter daily in response to the tides. The dynamism creates estuaries as a highly rich habitat. High water drifts in the rainy season and followed by low stream in the dry season produce periodic pulses. The intermixture between marine water and fresh water provide high value of nutrients in the water column, making estuaries among the richest natural ecosystem in the environment. This nutrients are very important for all organisms that live in estuaries include phytoplankton.

Phytoplankton is microscopic organisms that live in watery environments, both marine and freshwater and most of which are single celled. Like land plants, this microorganisms also have chlorophyll and can absorb sunlight for photosynthesis process and so called aututhroph. Photosynthesis is a natural process in phytoplankton that transfers absorbed photon light energy and convert inorganic carbon to become organic compounds [2]. Furthermore, photosynthesis performs a significant natural activity in the global carbon cycle and also supply food to promote all the heterotroph organisms. The process need chlorophyll, specifically chlorophyll a to convert light energy become chemical energy through the synthesis of organic compounds. Chlorophyll a is common to all photosynthetic organisms including microalgae. Concentration of chlorophyll a is also used extensively for estimating phytoplankton biomass.

Chlorophyll a is the photosynthetic pigment that causes the green color in algae and plants. The concentration of chlorophyll a present in the water is directly related to the amount of algae living in the water and also to determine water quality. Chlorophyll also is important to the exixtence of phytoplankton that can be used as an indicator organism for the health of a body of water. Analyzing chlorophyll levels in estuary is a direct method to understanding quality of estuary. The aim of this research is to analyze chlorophyll a concentration of phytoplankton in estuary area.

2. Material and Method
2.1. Description of study area
The research area was taken out in estuary area, specifically in estuary mangrove Kurau, Bangka Tengah, Indonesia. This site research is one of the tidal mouth of a river area in Bangka Belitung Province, Indonesia. This estuary bordered by Natuna Sea to the north and is located in southeastern part of Bangka Island. The research location was divided into four research stations which are mouth of Munjang Mangrove stream, mouth of River Kurau, near mangrove area, and transition zone between estuary and marine environments and its position between 2°18’26.886” LS and 105°98’158” BT (Figure 1).

![Map of Sampling Site](image)

**Figure 1.** Research Sampling Site

2.2. Water Sampling for Chlorophylla
Water samples were taken from estuary area by placing in 1.5 L dark bottle. The samples were collected 10 cm below surface estuary water and then immediately incubated in coolbox before transported and analyze them to laboratory. Exposure of samples to light during sampling can damage the phytoplankton and chlorophyll. The samples were stored in the refrigerator below 4°C when they could not be analyzed
immediately. The concentrations of chlorophyll a in phytoplankton were measured by spectrophotometer method or aceton method.

2.3. Environmental water parameter
Water parameters are important for analyzing chlorophyll a of phytoplankton in watery ecosystem. Those water environmental elements can effect to abundant of phytoplankton and chlorophyll a concentrations. An increase in the number of phytoplankton will enhance the amount of chlorophyll a in waters area. The characteristics of physicochemical estuary water parameters were taken for all research sites. The estuary water parameters that be taken were salinity (ppt), pH, water clarity (m), temperature (°C), sea water current (m/sec) and phosphate (mg/L).

3. Result and Discussion
Overall results, data of chlorophyll a concentration of phytoplankton in mangrove Kurau estuary area revealed in low rates in all sampling research area. The concentration of chlorophyll a in Mouth of River Kurau, transition zone between estuary and marine, near mangrove area and mouth Munjang stream were 0.0047 mg/L, 0.00117 mg/L, 0.00587 mg/L and 0.00117 mg/L, respectively (Table 1)

| Location                     | Chlorophyll a Concentration |
|------------------------------|----------------------------|
| Mouth of River Kurau         | 0.0047 mg/L                |
| Transition zone between estuary and marine | 0.00117 mg/L              |
| Near mangrove area           | 0.00587 mg/L               |
| Mouth Munjang Stream         | 0.00117 mg/L               |

This low rates of chlorophyll a concentration by reason of photic depth in mouth of River Kurau and transition zone between estuary and marine waters were only 0 m and 0.15 m with sea depth between 0.5 m – 0.3 m (Table 2). Photic depths of oligohaline area determine by sediments dilution from river flow. Still, estuaries are also under threat from human activities that contributes sediments accumulation in those area. Chlorophyll a concentration conform to water clarity and it is also greatly influenced by phytoplankton abundance [3]. Moreover, insufficiency of light transparency in mouth of Kurau River seemingly was due to increased sediment transport from tin mining in alongside River Kurau to estuary area. Due to of lack of water clarity, so that this condition could create low chlorophyll a concentration rates and it also affect to quality of water.

The important pigment groups are found in phytoplankton that is chlorophylls, phycobilins and carotenoids. Chlorophyll is a great fundamental component of photosynthesis which is phytoplankton acquires carbon dioxide and release oxygen by way of photosynthesis and obtains their energy. Photosynthesis is important due to aquatic animal organisms eat phytoplankton through food chains and use the energy that has been converted from the sun to organic compounds. However, when levels of concentration of chlorophyll a very fluctuated can be harmful to aquatic biota. In addition, photosynthesis is not just significant for phytoplankton, it is important to most other living things as well. Moreover, chlorophyll a concentration also is one of the key indicators in the study of the health status of any natural marine ecosystem. Variability of chlorophyll a concentration influences the ecological conditions of marine ecosystem such as the tranformations in the chemical and physical characteristics of the environment [4]. Furthermore, the concentration of chlorophyll a are reflection of the biomass of phytoplankton in an aquatic system as well [5].

Surface water column exchange of dissolved oxygen was also measured during these sampling date and found to contribute to the chlorophyll a concentration [6]. Dissolved oxygen is important for measuring gross primary production (GPP), net primary production (NPP) and respiration (R) rates in aquatic ecosystem. However, in this research site has value of gross primary production between 98.95 mg/L – 114.58 mg/L. Beside that value of net primary production and value of respiration (R) were 10.42 - 72.92 mg/L, 41.67 - 104.17 mg/L, respectively. Both GPP and NPP supports essentially all life
in the oceans and profoundly affects global biogeochemical cycles and climate. GPP and NPP depend on chlorophyll a concentration as well\textsuperscript{[7]}.

In Ketawai Island, near Kurau, rates of chlorophyll a concentrations have different value which are eastern coastal waters, southern coastal, western coastal, northern coastal were 4.128 mg/L, 0.19 mg/L, 0.15 mg/L and 0.824 mg/L, respectively\textsuperscript{[8]}. This island surrounds by coral reef and seaweed ecosystem. Based on the research in Kurau delta in December, value of chlorophyll a concentration was between 0.025 µg/L – 0.028 µg/L\textsuperscript{[9]}.

The mean rates of sea water parameters in Kurau estuary area: temperature, water clarity, salinity, sea water current, pH, phosphate were 29.5 ± 0.5 °C; 0.21 ± 0.15 m; 15 ± 12.74 ppt; 0.075 ± 0.032 m/second; 6.75 ± 0.83; 0.74 ± 0.52 mg/L, respectively (Table 2).

Table 2. Mean of water parameters of Mangrove Kurau Estuary

| Parameters          | Mean             |
|---------------------|------------------|
| Temperature         | 29.5 ± 0.5 °C    |
| Water clarity       | 0.21 ± 0.15 m    |
| Salinity            | 15 ± 12.74 ppt   |
| Sea water current   | 0.075 ± 0.032 m/second |
| pH                  | 6.75 ± 0.83      |
| Phosphate           | 0.74 ± 0.52 mg/L |

Surface water salinity of the estuary was different between each research sampling stations significantly. Rates of salinity in transition zone is higher than at the mouth of River Kurau on sampling date in April 2019. The value was 30 ppt in transition zone and then dropped to 0 ppt in mouth of River Kurau. Water clarity generally increased with distance from the estuary near mangrove to the mesohaline zone and having significantly greater light penetration than the rest of system\textsuperscript{[10]}. In estuary, phytoplanktons are a key of primary producers and can produce organic compound by photosynthesis process. This organisms move alongside the water bodies and can be transfered in and out with the tides. For that reason, it also creates fluctuative chlorophyll a concentration.

4. Conclusions

This study was to determine the chlorophyll a concentration in estuary area in Mangrove Kurau. The results showed that the concentration of chlorophyll a in Mouth of River Kurau, transition zone between estuary and marine, near mangrove area and mouth Munjang stream were 0.0047 mg/L, 0.00117 mg/L, 0.00587 mg/L and 0.00117 mg/L. It was considered low rate chlorophyll a since lack of light penetration in the research area. As part of plants, the abundant of phytoplankton will rise significantly in areas with high light penetration as well as chlorophyll a.

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