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Distribution of phytoplankton diversity and abundance in Mahakam Delta, East Kalimantan

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Abstract

The Mahakam Delta typically consisting of several ecosystems has been identified as one of biodiversity hotspot in Kalimantan Island. In order to provide phytoplankton distribution, diversity and abundance data, a research on 4 stations representing delta plain (ST1) and delta front (ST2, ST3, ST4) was performed. The studies describe phytoplankton community existing in this region and multivariate analysis using correspondent analysis (CA). There were 48 taxa phytoplankton belonging to Bacillariophyceae (35), Dinophyceae (6), Chlorophyceae (4), and Cyanophyceae (3). The highest taxa occurred in ST3 with diversity index of 2.09, followed by ST2 (1.95), ST1 (1.15), and ST4 (0.9). Diversity index of ST3, ST2, and ST1 delta was categorized as moderate stable community, while ST4 was categorized as unstable community. Bacillariophyceae was not only as the highest diversity class but also as the highest abundance, recorded in ST3. The abundance class ranged 1.4x105 cell/m^3 to 2.2x106 cell/m^3. Generally, phytoplankton diversity and abundance in delta front was higher than that in delta plain. Human activities and physical process likely influenced diversity and abundance of phytoplankton in Delta Mahakam.

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Keywords: distribution; diversity; abundance; phytoplankton; Mahakam Delta.

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1. Introduction

Mahakam Delta is one of watershed area in East Kalimantan and formed through sedimentation process [1]. Those are zones linking freshwater and marine systems, and are therefore characterized by gradients of chemical, physical and biological components in the water column [2]. Based on position and lithology, Mahakam Delta is divided into three important locations namely plain delta, front delta, and prodelta which have different characteristic [3].

These area become habitat for producer, consumer, until top predator creatures. The enhanced productivity increases consumer abundance and attracts higher trophic level organisms, creating biological hotspots in the ecosystem [4, 5]. Most studies analyzed sedimentation, environmental quality or forest biodiversity, however there are still less of water organism research and publication particularly about phytoplankton which actually has an important role in food chain. Environmental monitoring activities have been carried out by NGOs and companies who concern in oil and gas mining to observe biodiversity condition of sites around the Mahakam Delta.

The spatial mapping of phytoplankton assists to determine hotspots area based on abundance and diversity. Some studies analyze the spatial distribution and diversity of plankton [6, 7, 8]. The knowledge of phytoplankton distribution with reference to spatial pattern is important to determine the status of the ecosystem structure and functioning.

Measures of diversity are frequently seen as indicators of the status of ecological systems. Phytoplankton diversity has relationship with productivity in ecology [9, 10]. In addition, the diversity index may be used for habitat characterization [11, 12]. This study in Mahakam Delta, East Kalimantan describes phytoplankton, focusing on the spatial distribution of abundance and diversity. Considering the importance of plankton communities in these area for ecological role and conservation, we hypothesized that there are different spatial distribution and diversity of phytoplankton in several sampling locations.

2. Materials and methods

The study was performed in Mahakam Delta, East Kalimantan Province, Indonesia. The samples were taken from 4 stations representing plain delta and front delta. Station 1 (ST1) is categorized to delta plain which consists of active and inactive river channel, while ST2, ST3, and ST4 belong to delta front in center, north and south direction of Mahakam Delta. Delta front is sub-environments with high energy and sediments are constantly influenced by tidal currents, ocean currents along the shore, and the wave action [13].

Plankton sampling was carried out by filtering water samples as much as 50 liters by plankton net. Filtered water samples were stored in the sample bottle, and then preserved with Lugol solution of 10%. The samples were brought to be identified and classified by a binocular microscope and identification book [13, 14, 15]. The abundance of each plankton was calculated.

Univariate analysis approach was used to describe some ecological indicators through diversity index. The indicators were diversity and dominance index of the identified plankton species. Diversity index was based on Shannon and Wiener index [16] with the following formula:

$$H' = \sum_{i=1}^{n} pi \ln pi \quad (1)$$

Description: H'=Shannon-Wiener diversity index; pi=ni/N; ni=number of individual species-i^{th}; N=total number of individuals

Dominance index was determined using the following formula [16]:

$$D = \sum_{i=1}^{s} \left(\frac{ni}{N}\right)^2 \quad (2)$$

Description: D=Simpson dominance index; ni= number of individual-i^{th}; N=total number of individuals; S=number of genera