Biodiversity flora and fauna in tropical tidal lake

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Abstract. Tidal lakes are unique lakes because of the fluctuations of the water in the lake are influenced by the sea tides. Therefore, Tidal lakes are also called brackish lakes or salty lakes. Thus, the organisms that live in the lake must be able to adapt to the dynamics of brackish water changes. Therefore, the study of the biodiversity of flora and fauna is interesting to study related to organisms that are able to live and adapt to dynamic environments. This research was carried out in Siombak Lake, Medan City, North Sumatra Province from June to July 2018. The data collected were organisms in the form of flora (mangroves and aquatic plants) and fauna (ictiofauna or nekton which were fish, shrimp, crab, and mollusca). The results of research in the Siombak Lake ecosystem found 7 species of mangroves, 5 species of coastal plants, and 2 species of aquatic plant. Fauna found were 14 species of fish, 7 species of gastropods, and 1 species of bivalve, 1 species of shrimp and 1 species of crab.

1. Introduction

In general, lakes have two main functions, namely ecological and socio-economic and cultural functions. Ecologically, 1) lakes are a habitat for various aquatic organisms, such as fish, crustaceans, molluscas, including reptiles and amphibians; 2) lakes play a role in regulating climate (especially the microclimate), 3) lakes play a role in flood control (reservoir). Socio-economically and culturally, lakes have functions that are directly related to the lives of people surrounding the lake as well as local and central governments, such as agricultural activities (irrigation), domestic (clean water), fisheries (capture and cultivation), energy (hydropower), including Transportation and tourism [1][2]. Thus, globally, lakes are one of the sources of protein and food security, energy sources, economic resources, and employment, as well as sources of foreign exchange and regional income [3][4].

A large number of utilization activities and the pressure from increasing population make many lakes in Indonesia damaged. Therefore, the condition of most lakes has experienced ecosystem damage and decreased function. The main problems of damage and decline in lake function in Indonesia were 1) silting and narrowing of lakes, 2) water pollution (organic and toxic), 3) reduced biodiversity, 4) decreasing water debit [1][2][4]. With regard to biodiversity, one of the other problems was the low data collection of organisms in Indonesia, including in the lake [4]. Biodiversity was a wealth of micro and macro flora and fauna species found on the earth. Biodiversity was an invaluable legacy that helps enrich our lives (humans) and provides security for humans and other living beings. Their loss would cause the natural balance to be disturbed, thus impacting human life [1][5-7]. Therefore, it was necessary to identify and inventory the biodiversity of flora and fauna in Indonesia, one of which was Siombak Lake.
Siombak Lake is being lake located in Paya Pasir Village, Medan City, North Sumatra Province. This lake was formed from land dredging construction of the Belawan-Medan-Tanjung Morawa (Belmera) highway in the late 1980s. The area of Lake Siombak reached 28 ha with an average depth of 4.38 m at low tide and 6.25 m at high tide [8]. This lake was very unique because the water flowed from Siombak Lake was directly connected to the sea waters of Belawan (Malacca Strait). Therefore, fluctuations in the lake's daily discharge (water debit) are affected by the sea tides. Thus, this lake could be categorized as a brackish lake or salty lake. The tidal lake was a water body on the coast which waters are directly connected to the sea or the dynamics of its waters were influenced by the dynamical of sea tide [8-10]. The water body was connected to the ocean through a narrow door / channel (inlet) which could be in the form of a choked inlet, limited (restricted), and 'leaked' inlet [9]. The water environment conditions were very fluctuated, especially temperature and salinity [8][11]. Therefore, the flora and fauna that inhabit the lake were very unique and distinctive. Thus, the study of biodiversity in Siombak Lake was very important as an inventory and information on the wealth of flora and fauna in Indonesia.

2. Materials and method

2.1. Study site
This research was conducted in Siombak Lake, Medan City, North Sumatra Province, Indonesia. It was conducted in June-July 2018. The equipment used in this study were Garmin Oregon 65 GPS with accuracy up to 3 m, gill nets, mini hand nets, net trapped, crabs trapped, and Ekman grab.

2.2. Data retrieval procedure
Mangrove sampling using the observation method. The identification of mangrove plants was based on Giessen et al. [12]. Fish sampling was done using gill net and mini hand nets. Installation of the gill net was done around 9 am and lifted at 3 pm. Identification of fish samples referred to Kottelat et al. [13] and White et al. [14]. Type of crustacean taken was shrimp and mangrove crab. Shrimp samples were taken by using gill net along with fish sampling. Samples of mangrove crabs were collected using a crab trapped with 30cm x 30cm size. It was installed in the afternoon, and taken in the next morning. Samples of mangrove crabs and shrimp were identified referred to Carpenter and Niem [15]. Mollusca sampling was conducted using Ekman grab with the size of 30m × 30m. The identification of molluscas was referred to the Dharma [16].

2.3. Procedure for processing and analysing data
Data analysis was carried out descriptively and compared with other studies in tidal lakes.

3. Results and discussion

3.1. Mangroves and coastal vegetation
There were 7 species of mangroves (Acanthus ebracteatus, Acrostichum aureum, Avicennia marina, Bruguiera cylindrica, Nypa frutican, Rhizophora mucronata, Sonneratia alba) and 5 species of coastal vegetation (Hibiscus tiliaceus, Ipomoea pes-caprae, Stachytarpheta jamaicensis, Terminalia catappa, Wedelia flora) found around Siombak Lake (Figure 1). Nypa was the most abundant mangrove species and spreads evenly on the outskirts of Siombak Lake. This was quite reasonable because the range of salinity was quite low in Siombak Lake waters which were <15 ppt. Even in the rainy season, it could reach 3-5 ppt [11] [17]. The number of species and distribution of mangroves in Siombak Lake was much lower than mangrove vegetation in tidal lake Teluk Belukar (Nias-Indonesia), which was as many as 20 mangrove species and 17 species of coastal vegetation [18]. The higher mangrove diversity in Teluk Belukar lake because the lake was closed to the sea. This could be seen from the salinity value between 29 - 34.5 ppt [18] so that mangroves could grow well around Teluk Belukar Lake. While mangrove biodiversity in other tidal lakes found 8 types of mangroves in Lagoos Lagoon...
(Nigeria) [7], while in Chilika Lake (India) only 5 species of mangroves [5]. This showed that mangroves in Indonesia are higher than other African and Asian countries.

### Figure 1. Types of mangroves and coastal vegetation in Lake Siombak

3.2. *Aquatic macrophyta*

Found 2 species of aquatic plant, namely water hyacinth (*Eichhornia crassipes*) and *Cyperus* spp. (Figure 2.). This type of aquatic plant was a water weed. Water hyacinth is a type of water plant that floats and it was not the original plant of Siombak Lake. This plant was an introduction plant from Latin America [19]. Water hyacinth in Lake Siombak came from a river that was carried by the current into the lake. Macrophyta plants in Chilika Lake found marine plants, such as Potamogeton, Halophila, Gracilaria, Ruppia [20], including in Kakaban Lake (Derawan-Indonesia), there was Halimeda [1]. This was related to the level of salinity in the Siombak Lake categorized as brackish and tend to be fresh water, while Chilika lake and Kakaban lake were classified as salty (sea).

3.3. *Fish*

Fish found in Siombak Lake were 13 species (Figure 3). There were two groups of fish found in the lake, namely freshwater fish that were able to adapt to the presence of salinity, such as sepat siam (*Trichogaster pectoralis*), tilapia (*Oreochromis niloticus*), mujair (*Oreochromis mossambicus*), gabus (*Channa striata*), manyung (*Netuma thalassima*) and kepala timah (*Aplocheilus panchax*). The other
groups were brackish fish inhabitants of estuary such as belanak (*Valamugil seseli*), belanak (*Chelon subviris*), julung-julung (*Hyporhampus quoyi*), ketang (*Scatophagus argus*), and kerong-kerong (*Terapon jarbua*), and Bandeng (*Chanos chanos*). The most common types of fish that were found many in number and always to be found were *Valamugil seseli*, *Chelon subviris* and *Oreochromis mossambicus*. This was not surprising because these types of fish were fish that able to adapt to the salinity range.

![Figure 2. a) Enceng gondok (*E. crassipes*), b) *Cyperus* spp. in Siombak Lake](image)

![Figure 3. Fishes species found in Siombak Lake (partly taken from Muhtadi et al. [16]](image)

The existence of estuary fish in Siombak Lake is related to the condition of waters that categorized as the brackish (estuary). The Mugilidae and Ambassidae families were the estuary inhabitants. Which stated that the Mugilidae and Ambassidae family have the widest composition distribution in estuary
including mangroves. This fish lived in a wide range of salinity because it could live in freshwater, brackish and seawater that associated with reefs. These types of fish were often entering estuaries and rivers, were catadromous, usually formed large groups in areas with sand or mud substrate [20-22].

Fish in other tidal lakes found as many as 8 species in Teluk Belukar. Generally, fish in Teluk Belukar were categorized as marine fish, from the group of Mugilidae and Carangidae [18]. While in Chilika Lake there were 317 species [23], in Lagoos lagoon there were 80 species [24], in Nokoue Lake were found 51 species [25].

3.4. Crustaceans
There were 1 species of shrimp and 1 species of crab in Siombak Lake, namely white shrimp \((\text{Penaeus marguensis})\) and Mangrove crab \((\text{Scylla serrata})\) (Figure 4). The presence of marine crustaceans in Siombak Lake due to the influence of sea tides and mangroves found on the outskirts of the lake. As reported from other tidal lakes that found sea shrimps and mangrove crabs in the lakes [5-7][18] Chilika Lake itself found 28 species of shrimps and 38 species of crabs [5] Basically the group of shrimp spawned and nursery in the mangrove area, and they would return to the sea after growing up. Whereas mangroves were suitable habitats for mangrove crabs [22][25][26].

![Figure 4. Shrimp and mangrove crabs that found in the Siombak Lake](image)

3.5. Mollusca
Molusca was a group of macrozoobenthos which were found many in waters either submerged into the substrate or on the surface of the substrate, including attached to the roots or stems in the littoral zone of the lake. Molluscas found in Siombak Lake consisted of 1 species of bivalve class and gastropods found 7 species (Figure 5). In general, molluscas inhabit the lake was from the gastropod group [16].

![Figure 5. Molluscas that found in Siombak Lake](image)
4. Conclusions
Flora and fauna found in Siombak Lake were estuary type organisms, which were organisms that able to adapt to sea tide dynamics, especially salinity dynamics. Nypa fruticans was a type of mangrove that has a high distribution on the outskirts of Siombak Lake. Oreochromis niloticus, Valamugil seheli, and Chelon subviris were fish that have distribution and most often found in Siombak Lake.

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