FISHERIES AND MARINE
The Composition and Distribution of Phytoplankton on Seagrass Ecosystem at Gili Asahan, Sekotong, West Lombok

Chandrika Eka Larasati (1*), Ibadur Rahman(1)

(1)Department of Fisheries and Marine Sciences, Faculty of Agriculture, Mataram University, Indonesia
*email: chandrikalarasati@unram.ac.id

Abstract

Phytoplankton is one of marine organisms lives on seagrass ecosystem and has much contribution to total primary production in marine. This research aims to analyze the abundance and diversity index of phytoplankton on seagrass ecosystem at Gili Asahan, Sekotong sub-district, West Lombok regency. It was done on August, 5th 2018 at two different stations decided using survey method. The sample was collected from 100 liters of water on seagrass bed filtered using plankton net 0.25mm. The results showed that there were 13 diatom genera of Bacillariophyceae which abundance ranges from 668 to 8,855 cells/L. Nitzschia was the most abundance phytoplankton genus found at station 2. The diversity index ranges between 2.12-2.30 which means that the phytoplankton community is consisted of only a few species and that it has a tendency towards certain species of phytoplankton to dominate.

Keywords: phytoplankton, seagrass, Gili Asahan, diversity index

1. Introduction

Gili Asahan is an island located in Sekotong District, West Lombok. This area has seagrass and mangrove ecosystems. Seagrass ecosystems are found on the western, northern and southern sides of the island. While mangrove ecosystems are found in the eastern and southern parts of the island (Ppk-kp3k.kkp.go.id). The substrate along the coast of Gili Asahan is sand, so there are more variations in seagrass species than mangroves. Seagrass serves as a shelter for marine life, for feeding and spawning. Seagrass communities are dynamic and easily changed due to changes in biomass without any changes in area, species composition, growth and productivity (McKenzie et al., 2003). One organism that lives around seagrass ecosystems is phytoplankton.

Phytoplankton is a microscopic plant that lives in water columns which its movements are influenced by currents (Sachlan, 1982). Like land plant, phytoplankton is
primary producer capable of forming organic substances from inorganic substances in photosynthesis (Adinugroho et al., 2014). Phytoplankton plays some vital role in marine waters as the main supplier of oxygen, natural food for fish larvae and other organisms like shellfish, toxic gas absorbers, and as the indicator of water fertility and water pollution (Lobelle et al., 2013). Thus its presence determines the diversity and the amount of other marine organisms (Cokrowati, 2015). Phytoplankton has a response to environmental changes, so it is widely used as a water bio-indicator. Therefore, it is necessary to study the composition and distribution of phytoplankton, especially that on seagrass ecosystem of Gili Asahan, Sekotong, West Lombok.

2. Material and Method

This research was conducted on seagrass bed ecosystem of Gili Asahan, Sekotong, West Lombok (Figure 1) on August 2018. The analysis of water sample quality, phytoplankton identification and calculation was carried out at Bio-ecological Laboratory of the Aquaculture Study Program, Mataram University. Research location was determined purposively based on characteristics and people activities on that location. So it was divided into 2 different stations; Station 1 on the west of the island, and Station 2 in the south which is a residential area.

![Research location map](image)

Figure 1. Research location map

Water parameters analyze were dissolved oxygen, temperature, pH, salinity, depth, and phytoplankton. Sampling of phytoplankton was carried out at each station by taking
100 liters of surface water around 0-30 cm, then filtered with plankton net 20 µm (Larasati, 2015). The filtered water was put in a 100 mL bottle and dropped with 4 drops of Lugol's solution (Sahu et al., 2012). Phytoplankton samples were calculated using the Sedgwick rafter cell method with 100X magnification (APHA, 2005). Phytoplankton was identified referring to the book of Yamaji (1966), Hasle et al., (1996), and Omura et al., (2012).

Phytoplankton abundance is calculated by the formula:

\[
N = n \times \left( \frac{v_t}{v_{cg}} \right) \times \left( \frac{A_{SRC}}{A_a} \right) \times \left( \frac{1}{v_d} \right)
\]

Where:
- \( N \) = Phytoplankton abundance (cell m\(^{-3}\))
- \( n \) = Number of cells observed
- \( v_t \) = Filtered water volume (ml)
- \( v_{cg} \) = Sedgwick Rafter Cell volume (ml)
- \( v_d \) = Total filtered water volume (m\(^3\))
- \( A_a \) = Observation area in SRC (997.5 mm\(^2\))
- \( A_{SRC} \) = Area of SRC (1000 mm\(^2\))

The diversity index (H') and uniformity index (E) was calculated with diversity index formula of Shannon-Wiener (Odum, 1993):

\[
H' = -\sum p_i \ln p_i \quad E = H'/H'_{maks}, \quad H'_{maks} = \ln S
\]

Where:
- \( p_i \) = The ratio between the number of individuals of each species and the total number of individuals per species, \( p_i = n_i/N \)
- \( n_i \) = The number of individuals of each species
- \( N \) = The total number of individuals per species
- \( S \) = The total number of individuals of all species

The dominance index (D) is used to see the dominance of any species in a community which is calculated based on the Simpson index (Dianthani, 2003), i.e.:

\[
D = (n_i/N)^2.
\]
3. Results and Discussion

The Composition and Abundance of Phytoplankton

The results showed that there were 13 diatom genera of Bacillariophyceae, i.e: Biddulphia, Coscinodiscus, Clicmacosphenia, Cylindrotheca, Diploneis, Licmophora, Lyrella, Navicula, Nitzschia, Palmeria, Pleurosigma, and Rhabdonema. Bacillariophyceae is a common phytoplankton class found in marine water. Sachlan (1982) states that phytoplankton live above 20°/00 of salinity are mostly from the Bacillariophyceae class.

The abundance of phytoplankton is varies and quite high at Station 2 (Figure 2), especially Nitzschia which has the highest abundance (8,855 cells/L). Nitzschia are commonly found in tropical regions because their ability to adapt in varied environmental conditions (Yamada et al., 2013). However, those species have high potential for HABs (harmful alga blooms) which can lead to the occurrence of ASP (Amnesia Shellfish Poisoning) (Hallegraef, 1993) which can result in neurological disorders, brain damage, memory loss, even death in humans (Omura, 2012).

Toxin production is a way of diatoms to protect themselves from predation (Gleason et al., 2015). The toxin will easily get into the shellfish meat until humans finally consume it. The abundance of Nitzschia species at Gili Asahan waters is still relatively low and innocuous compared to those in North Jakarta which reached 633,420 cells/L (Mulyani et al., 2012)

Station 2 has more abundance of phytoplankton than at Station 1. This is because Station 2 is located near the dock and pearl oysters cultivation also the existence of settlements. So it has potential to produce more organic matters and nutrients than Station 1. Coscinodiscus species are more abundance at Station 1 that at Station 2. This probably caused by the strong water current at Station 1, because Coscinodiscus has the ability to live even in strong water currents (Larasati, 2015).

Water Parameters

Water quality analysis is measured to know which parameters that support the growth of phytoplankton. Water physical and chemical parameters measured are dissolved
oxygen, temperature, pH, salinity and depth. The concentration of each parameter at the two different stations has varied values (Table 1).

![Figure 1. The abundance of phytoplankton at GiliAsahan](image)

Water quality parameters are relatively good for phytoplankton growth in accordance with quality standards for marine biota (MENLH, 2014). Dissolved oxygen (DO) content is insignificantly different but sufficient for the growth of phytoplankton. Simanjuntak (2009) states that DO content is influenced by temperature, salinity, photosynthetic activity and respiration for marine plants like phytoplankton.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Station 1</th>
<th>Station 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO (mg/L)</td>
<td>7.65</td>
<td>7.03</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>27.73</td>
<td>28.15</td>
</tr>
<tr>
<td>pH</td>
<td>8.38</td>
<td>8.47</td>
</tr>
<tr>
<td>Salinity(°/00)</td>
<td>31.33</td>
<td>31.5</td>
</tr>
<tr>
<td>Depth (m)</td>
<td>0.75</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Water pH at both research stations ranged from 8.38 to 8.47. This value indicates that the waters is good for phytoplankton growth. The salinity concentration obtained during the research did not differ significantly (31.33-31.5). The difference in salinity is caused by the input of freshwater mass at low tide originating from the land so that the salinity becomes low. Whereas at high tide, the salinity value is high because of the coming sea water supply (Larasati et al., 2015).

**Index of diversity, uniformity and dominance**

The diversity index of phytoplankton ranges from 2.12-2.30 (Table 2). It indicates that the level of diversity of the phytoplankton community at GiliAsahan classified as moderate (Wilhm and Doris, 1968). The diversity index value shows the relationship between environmental conditions with physical chemistry of water (Adinugroho et al., 2014). In addition, diversity index between 1-3 indicates that community stability is at a moderate level (Pirzan and Masak, 2008).

The uniformity index of phytoplankton ranges from 0.82-0.89. The index shows that the level of uniformity each species spread evenly and there is no tendency for any species of phytoplankton to dominate the community.

Table 2. Diversity index (H’), uniformity (E), index of dominance(D) and the total abundance of phytoplankton at GiliAsahan

<table>
<thead>
<tr>
<th>Station</th>
<th>Total abundance (cells/L)</th>
<th>Diversity index (H’)</th>
<th>Uniformity index(E)</th>
<th>Dominance index(D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>34,586</td>
<td>2.30</td>
<td>0.89</td>
<td>0.1</td>
</tr>
<tr>
<td>2</td>
<td>37,928</td>
<td>2.12</td>
<td>0.82</td>
<td>0.1</td>
</tr>
</tbody>
</table>

The dominance index value indicates that no species of phytoplankton dominating the waters of GiliAsahan. Krebs (1989) states that the dominance value ranges from 0 to 1. The more the value is close to 1, the more dominant that species in the community.

**4. Conclusion**

There were 13 genera of phytoplankton (diatoms) of Bacillarioohyceae class found during the research, i.e.; Biddulphia, Coscinodiscus, Clicmacosphenia, Cylindrotheca,
Diploneis, Licmophora, Lyrella, Navicula, Nitzschia, Palmeria, Pleurosigma, and Rhabdonema. The highest abundance of phytoplankton is 8,855 cells/L. The diversity index ranges from 2.12 - 2.30, the uniformity index ranges from 0.82 - 0.89, and the dominance index is 0.1. Those indexes show that the phytoplankton community has a moderate diversity and level of stability, so that no species dominates in the seagrass ecosystem of GiliAsahanSekotong, West Lombok Regency.

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References


