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Plankton abundance in ecosystem of Tebing Tinggi Island, District Meranti Island, Riau, Indonesia

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Research on the abundance of plankton in Tebing Tinggi Island waters ecosystem, Meranti Island District, Riau Province was conducted in March 2017. The observations focused on the phytoplankton and zooplankton communities at ten stations. The variations in the abundance of plankton on average between the location groups were 4428 to 1716224 cells/m^3 and 23938 individuals/m^3 (67.73%), respectively for phytoplankton and zooplankton. The structure of the phytoplankton community was observed to be dominated by 5 diatoms: *Coscinodiscus, Chaetoceros, Guinardia, Navicula,* and *Pseudonitzshia* species. However, the pre-dominant genus (>10%) was *Coscinodiscus* spp. with an abundance of 664,665.97 cells/m^3 (99.47%) at station 5. Of the dinoflagellate group, only *Ceratium* clans were with the highest abundance in station 7 of 324609 cells/m^3 with the location to the north of the Black Water Strait, but still in normal condition. The macroplankton community structure is dominated by the copepods group especially Calanoida, Cyclopoida and Nauplius copepods with high densities of more than 50%. On the other hand, information about the mangrove forest ecosystem and associated fauna in the ecosystem in the coastal area of Tebing Tinggi Island is still lacking. It is, therefore, necessary to conduct research that can be used as a basis to create a concept of management of marine resources in the region.

Keywords: Plankton, environment condition, Tebing Tinggi Island.

INTRODUCTION

The coastal zone is a mixing area between land and sea regimes, as well as forming a dynamic balance of each component. The interaction between mangrove forest organisms and their environment in coastal waters is able to create environmental conditions that are suitable for the biological process of various types of aquatic organisms. Coastal areas that have these three ecosystems usually have very high productivity (Chen et al., 2013; Coulter and Allaway, 1979; Van Ty et al., 2012). In addition, ecologically these three ecosystems can play a role as a stabilizer of coastal stability, both from land and sea influence.

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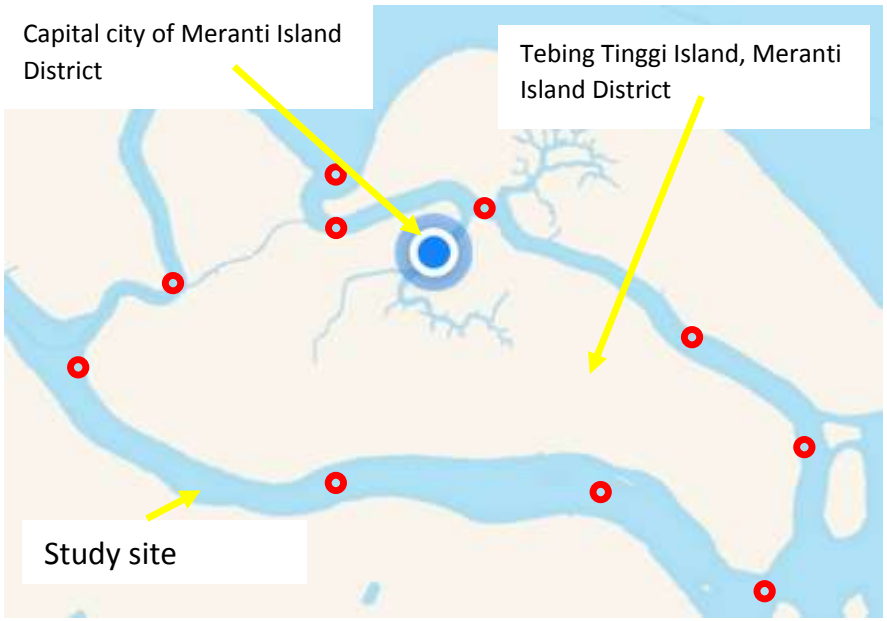

Figure 1. Map of plankton observation station location on Tebing Tinggi Island.

As mentioned by Ridd et al. (1990) and Fratini et al. (2004), that the waters around the mangrove forest play a key role in the nutrient rotation, so that its existence can play a role in supporting and providing a marine biota, if the environment is relatively stable, conducive and not too fluctuating. Similarly with mangroves, experts point out that the main function of mangroves is in the recycling of nutrients indispensable to marine life (Roy and Bersdate, 1970; Goering and Parker, 1972). The rapid progress of development and the high needs of human life, have a negative impact on the quality and quantity of these ecosystems. This condition is now happening in most coastal areas in Indonesia, among others along the coast of small islands in the province of Riau and in some coastal areas in Riau Islands Province (Praseno and Sugestiningsih, 2000).

Associated with the declining quality and quantity of coastal area in some areas in Indonesia mentioned earlier, the beach area of Tebing Tinggi Island is one of the coastal areas whose condition is still relatively good. Coastal areas and beaches of Tebing Tinggi Island are intended to be used as a marine conservation area, but information on the existence of the three ecosystems and biota that live therein is still very limited or even not exist. Information about the existence of ecosystems and associated biota in it, including connectivity among ecosystems in the coastal area of Tebing Tinggi Island is very important, because the data is used as a basis in determining the policy and management of the future. Therefore, to fulfill this information, research that reveals the extent of the mangrove ecosystem and the diversity, density and biota living in it needs to be done.

In relation to the aforementioned, local people utilize marine resources in the Island of Tebing Tinggi, but they are only used for local consumption. Nevertheless, the utilization and harvesting of biota in the area from year to year will surely increase. On the other hand, information about mangrove forest ecosystems and associated fauna in these ecosystems in the coastal area of Tebing Tinggi Island is still lacking. In an effort to anticipate and overcome the occurrence of over-exploitation and improper management, it is necessary to conduct research that can be used as a basis to create the concept of marine resource management in the region.

MATERIALS AND METHODS

Study area

Plankton observation was conducted in Tebing Tinggi Island Waters, Meranti Islands District (Figure 1). These waters are relatively shallow with water depth between 5 and 29 m.

Plankton study

Examples of plankton were taken from 10 stations using plankton nets with specific specification according to their species: for phytoplankton used plankton net with 80 µm mesh size, mesh mouth diameter 0.31 m and mesh length 100 cm; for zooplankton used plankton net with mesh size 300 µm, diameter of mesh net 0,45 m and net length 180 cm.

In each mesh, the plankton is equipped with a flowmeter to measure the volume of water entering the web. Measurement of

filtered water volume is calculated by the formula:

$$V = R \; x \; a \; x \; p$$

where V is the filtered water volume (m^3), R is the number of rotation of flowmeter vanes, a is the wide mouth mesh, and p is the column water length (m) taken for one rotation.

Sampling is done horizontally on the surface of the drawn waters for 2 to 3 min at constant speed. Samples were collected in a sample bottle fed formalin with a concentration of 4% and then chopped and identified in the laboratory using a high power microscope.

The phytoplankton enumeration is performed by using "Sedgwik-Rafter Counting Cell" over the sample fraction and the result is expressed in cell/m^3. While for the zooplankton samples the enumeration and identification were performed using Bogorov cups and the results were expressed in individuals/m^3 (Praseno and Sugestiningsih, 2000; Wickstead, 1965).

RESULT AND DISCUSSION

Phytoplankton

From the results of the research in March 2017 recorded the composition of the phytoplankton clan in the waters of Tebing Tinggi Island, Meranti Islands Regency amounted to 13 genera, consisting of 10 genera diatoms and 3 genera dinoflagellate, composition dominated by diatoms clan. The diatom genus, which has an event frequency of more than 90%, has 5: *Coscinodiscus*, *Chaetoceros*, *Guinardia*, *Navicula*, and *Pseudonitzshia*. However, the pre dominant genus (>10%) is *Coscinodiscus* with an abundance of 664,665.97 cells/m^3 (99.47%) at station 5, *Coscinodiscus* is predominant or there are five types of diatoms with an event frequency of more than 90%, or obtained almost in all waters. These symptoms are often seen in temperate waters and usually take place in the spring and are known as Spring Diatoms Increase (SDI) (Taylor, 1994). In the waters along the tropical coast, especially around the river mouth, the abundance of diatoms is largely due to land mass effect as a result of the carrying of nutrients from rice fields, fields, industrial wastes and household wastes through river water to the sea and also because of turbulence (stirring) by tidal waves and deep ocean currents to the more shallow (Russell-Hunter, 1970). The theory relating to the natural difference in terms of growth and development, Shumway (1990) explains that the life cycle of phytoplankton takes place much faster than zooplankton. Of the dinoflagellate group, only the *Ceratium* clan with the highest abundance in station 7 was 3.246.09 cells/m^3 with the location upward on the Black Water Strait but still under normal conditions. The dinoflagellate abundance was not found at station 3 with near-land location close to Rangsang Island and station 10 between Merbau Island and the Black Water Strait, but the cell content was generally low (<10%), so it was not alarming. Judging from the amount of plankton abundance obtained, it can thus be said that these waters are fertile enough for nutrients, because the location of the study is inhabited by mangrove forests, known as a producer area of fertile organic substances.

Predominant clinic phytoplankton

Diatoms group

***Coscinodiscus* Her.:** The first description was made by Throndsen (1978). The form of flat cells such as disc with a flat or slightly curved valva. The cell diameter is about 73 µm. The image that appears on the valva side is very rough. The centre of the building is not visible roses. The image on the valva side is shaped like a hole of the same size, 3 to 4 in 10 um. At the edge of the valva the building is slightly smaller size 6 to 8 in 10 um. In High Cliff, water is found throughout the station (St. 1-10). This species is commonly found in the waters of Cape Samak, waters of Alai, Water Strait Black, Karimun Waters. Originally, these genera are commonly reported from temperate waters and are recorded from the waters of the North Atlantic, the North Sea, the Baltic Sea, the British Channel, and the Irish Sea, the coastal waters of France, the Mediterranean and the Pacific (Frederiksen et al., 2006).

***Chaetoceros* Grunow:** The first description was made by Hallegraeff (1993); the cells form a rigid chain. Valve shape angled 4 or 6, rarely elliptical. Size of cell width varies between 18 and 60 µm. Setae emerge from the angles of the apical part of the cell with the short and firm bottom of the Setae. Setae is protruding out in a slightly diagonal direction. Setae from the lower end of the cell end of the chain is shorter, often thicker, first leading to the side, then parallel to the chain axis. This type is commonly encountered, both in the waters of Cape Samak and Alai waters. Hallegraeff (1993), explains that this clan only is spread among others in the British Channel, Belgian coastal waters, and the Atlantic coastal waters of North America. In High Cliff waters, the clan is found at stations 2, 3, 5, 6, 9, and 10 (Figure 1).

***Ceratium* (Ehrenberg) Dujardin:** First called *Peridinium furca* Ehrenberg, but then moved to the *Ceratium* clan. The shape of a straight cell is somewhat flat-dorso-ventral with one horn on the apical part and two anterior horns. Hipoteka has one short right horn and one left horn that is twice as long. Both horns are located parallel or slightly protruding out. *Ceratium furca* is a cosmopolitan type and sometimes leads to red tide in Japanese waters (Fukuyo, 1981). In High Cliff waters, this type is commonly found in almost all stations except

stations 3 and 10 (Figure 1).

Zooplankton

Overall zooplankton that was identified in this study amounted to 33 orders. In general, the composition of zooplankton consists of Copepod especially Calanoida, Cyclopoida and Nauplius copepods with a high density of more than 50%. Of this copepods group, Calanoida is pre-dominant (50%) with the largest abundance of 23938 individuals/m^3 (67.73%). Other zooplankton taxa are Chaetognata, Polychaeta, Oikopleura, Gastropod, Bivalves, fish eggs, and fish larvae. These seven taxa zooplankton generally have a high percentage of density (>10%), except Polychaeta not found at station 9. The abundance of zooplankton in High Cliff waters contains twice as many zooplankton as the Bengkalis and Malacca Straits. The predominant zooplankton tax (>10%) obtained from this observation varied more as a predominant zooplankton for 20 years (Arinardi, 1995). This confirms that the content of zooplankton in the waters of Tebing Tinggi is denser than in the southeastern part of the Strait of Malacca. The development of Copepod percentage and abundance that always dominates throughout the waters. Copepods are always the predominant component of zooplankton, indicating that these waters are potentially enough to support the life of pelagic marine biota. This is supported by expert research, which states that pelagic fishes such as anchovy, bloating (Rastrelliger sp), lemuru (Sardinella lemuru), tembang (Sardinella gibbosa) and even skipjack (Katsuwonus pelamis) are predatory as predators of Copepod and decapod larvae. Generally, the zooplankton community is dominated by Copepod. This is in accordance with Wiadnyana and Praseno (1997) assertion that the Copepod group should be aware that in a normally normal environment, the marine biota cluster is almost always closely related to the number of feed prey in waters. Copepod as the dominant element found in zooplankton community in High Cliff waters especially Calandra and Cyclopoid is a type of Copepod neritic. These copepods are relatively larger in size and commonly live in inland-induced waters, such as those found in the Java Sea (Arinardi, 1995). Copepods that are always the predominant component of zooplankton also identify that the high cliff waters are sufficiently potential to support pelagic marine life. This is supported by expert research, which states that pelagic fishes such as anchovy, bloating, lemuru, tembang and even skipjack are predatory as predators of Copepod and Decapod larvae (Soerjodinoto, 1960; Burhanuddin and Hutomo, 1975; Sutomo and Arinardi, 1978). It should be realized Goulter PFE, Allaway WG (1979). Litter Fall and Decompostion in a Mangrove Stand, Avicennia Marina (Forsk.) Vierh., in Middle Harbour, Sydney. Mar. Freshw. Res. 30(4):541–546.that in a normally normal environment, the cluster of marine biota is almost always closely related to the number of food prey in water (Tham, 1950, 1953; Sánchez et al., 2013) (Figure 1).

Conclusions

Genera diatoms *Coscinodiscus*, *Chaetoceros*, *Guinardia*, *Navicula*, and *Pseudonitzshia*, are found throughout the High Cliff waters with an incidence frequency of more than 50%, while the predominant genus is *Ceratium* and *Protoperidinium* from the dinoflagellate group. Taxis from the Copepod, Polychaeta, Chaetognata, Bivalia, Gastropod and Oikopleura groups have high but high-density events, but only from the copepoda Order especially Calanoida with an abundance of more than 50%. The results showed that the waters of Tebing Tinggi have more density so that it can be said that the waters of Tebing Tinggi is fertile enough for nutrition.

CONFLICT OF INTERESTS

The authors has not declared any conflict of interests.

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