Abundance of sea cucumbers on the ecosystem of seagrasses
Inunggeh island, Tapanuli Tengah Regency North Sumatera Province

M M Wisesa¹, D Bakti² and A Fadhilah²
¹Student of Water Management Resources, Faculty of Agriculture, Universitas Sumatera Utara
²Lecturer of Water Management Resources, Faculty of Agriculture, Universitas Sumatera Utara
E-mail: dbakti06@yahoo.com

Abstract. Unggeh Island is one area that has the potential of Sea Cucumber in the North Sumatra. Sea cucumbers have an important role in ecosystem waters, namely as a deposit feeder. Sea cucumbers can live in shallow waters, such as seagrass ecosystems. The purpose of this study is to knowing the abundance of sea cucumbers in the seagrass ecosystems on the island of Unggeh and to knowing the type of Sea Cucumber. The method used is a transect quadrant method with a size of 5x5 meters, on a transect line with a length of 100 meters. Sampling was done at three points observations, station 1 was at coordinate point 01°34'26,88 "LU and 098°45'40,25" BT, station 2 was at coordinate point 01°34'32,71 "LU and 098°45'37, 58 "BT, station 3 is at the coordinate point 01°34'24,22" LU and 098°45'38,06 "BT. The type of sea cucumber found in the seagrass ecosystem on the Unggeh island Actinopyga ecinites, A. Miliaris, Holothuria scabra. The density at station 1 was 0.16 ind / m², at station II a density was 0.12 ind / m², at station III a density was 0.08 ind / m², and the total density at the research location was 0, 32 ind / m².

1. Introduction
The Indonesian sea has a very diverse wealth. In terms of ecosystems, biota-biota and biological resources contained therein. This natural wealth can be seen one of them from the biological resources of the waters. Various types of nekton, echinodermata, crustaceans, mollusca, plankton. Sea cucumbers are one of the marine biological resources that are quite abundant and scattered in Indonesian waters. These animals have many benefits for human life.

Sea cucumbers are spread over several marine waters, including in Indonesia. Habitat sea cucumbers in the form of seagrass ecosystems and coral reef ecosystems, ranging from the intertidal zone to a depth of 20 meters. In general, sea cucumbers require an environment that is not polluted. Some environmental parameters that affect the presence of sea cucumbers are temperature, pH, water turbidity, dissolved oxygen, ocean currents, light penetration, water salinity, substrate, nitrate, nitrite, orthophosphate, biological oxygen demand, and suspended solids [1]. Sea cucumbers include one of thorn-skinned animals or Echinodermata [2]. Sea cucumbers are commonly found in areas where algae or seagrass beds are found[3].

Unggeh Island is located in Sitardas village of Badiri district, Central Tapanuli district at coordinates between 1°34'23 "- 1°34'37" LU and 98°45'42 "BT. The ungeh island is located about 11 miles from the mainland of Sumatra and is an overgrown island of flora such as coconut trees bushes, ketaping trees and several other wood species [4].
2. Research methods

This research was conducted in the area of Pulau Unggeh Badiri District, Central Tapanuli Regency, North Sumatera Province. Observation abundance of sea cucumbers done in the field. Data analysis was conducted at Integrated Laboratory of Water Resource Management Faculty of Agriculture, University of Sumatera Utara. Water quality analysis was done at Balai Teknik Kesehatan Environments and Disease Control (BTKLPP) Class I Medan. Substrate analysis was conducted at the National Standardization Research Center. Research location can be seen in Fig. 1

The tool used is digital camera, Global Positioning System, identification book, stationery, calculator, secchi chip, tool box, stationery, ball, meter 100m, underwater camera, thermometer and pH meter, refractometer, 5x5 m, sample bottles, tracing paper, DO meter, cement ladle. General Manual of Identification and Monitoring of Sea Cucumber Population [5]. The materials used are Microsoft Excel software, plastic bags, sea cucumber samples, water samples, substrate samples and label paper.

The method used in collecting data of sea cucumber is observation (survey) field as shown in (Figure 1) to determine the location of sampling, plotting GPS. The area of the transect depends on the number of personnel, the density of sea cucumbers and the area of the area to be surveyed, 5 x 5 meters (distance between plots 5-10 meters) or 10 x 10 meters (distance between plots 5-10 meters). Distance between transects from 50 meters up to 10 meters. There are at least 3 plots in 1 transect, and the number of plots should be increased to represent the extent of the waters being monitored (reaching the edge) [5].

2.1 Water Quality Measurements

Water quality data collection is done once before transect abundance of sea cucumber is done. Measurements are made by using the prepared equipment. Measurement of water quality parameters can be seen in Table.

| Parameter          | Peace | Tool            | Analysis  |
|--------------------|-------|-----------------|-----------|
| Temperature        | ºC    | Thermometer     | In situ   |
| Salinity           | ppm   | Refraktometer   | In situ   |
| Bright             | %     | Secchi disk     | In situ   |
| Depth              | cm    | Scaled sticks   | In situ   |
| Current Velocity   | m/s   | Ball guessed    | In situ   |
| Substrate          | -     | -               | Ex situ   |
| Chemical           |       |                 |           |
2.2 Data Analysis

The Density

The density of Sea Cucumber (Holothuroidea) is calculated by using the formula [5], which are:

\[
X = \frac{\sum X_i}{n}
\]

Information:
- \(X\): Average number of sea cucumbers widespread unity
- \(\sum x\): Number of sea cucumbers in I unit
- \(N\): The total area of I unit

Index of species diversity

Species diversity can be regarded as an indication of the number of types of macrobenthos and how the spread of the number of individuals in each type and location of the sampling. To determine the diversity is calculated using the following Shannon-Wiener [5] formula:

\[
H' = -\left(\sum \frac{n_i}{N} \ln \frac{n_i}{N}\right)
\]

Information:
- \(H\): Index of Species Diversity
- \(n_i\): Number of individual types of i
- \(N\): Total number of individuals

| No | Stability Range | Diversity          |
|----|----------------|--------------------|
| 1  | 0 < \(H'\) ≤ 1 | Low (unstable)     |
| 2  | 1 < \(H'\) ≤ 3 | Medium             |
| 3  | \(H'\) > 3     | High (stable)      |

Index of Uniformity

This index is used to determine the existence of the type that dominates the community and to know the spread of the number of individuals of each species. This index is obtained by comparing the index of diversity with its maximum value [5] using the following formula:

\[
E = \frac{H'}{H_{\max}}
\]

Information:
- \(E\): Uniformity index
- \(H'\): Index of diversity
- \(H_{\max}\): Maximum species diversity (In S)

Values range from 0 and 1. The smaller the value of E, the smaller the value of uniformity. This shows the spread of the number of individuals of each species is not the same and there is a possibility that the population is dominated by a type of biota. Conversely, the greater the value of E, the higher
the uniformity of the biota population. This shows that the number of individuals of each species is the same, where the population is not dominated by a biota type.

**Index of dominance**

To calculate the simpson dominance index [5] as follows:

$$D = \sum \left( \frac{N_i}{S} \right)^2$$  \hspace{1cm} (4)

Information :

- $D$: The dominant index of simpson
- $N_i$: Number of individual species
- $N$: Total number of species
- $S$: Number of types

The $D$ value is categorized as follows:

- $0 < D \leq 0.5$ low dominance
- $0.5 < D \leq 0.75$ moderate dominance
- $0.75 < D \leq 1.00$ high dominance

3. Results and Discussions

3.1 Samples of sea cucumbers

From research conducted in Pulau Unggeh Subdistrict of Badiri Regency of Central Tapanuli, got some kind of sea cucumber, Actinopyga milliaris, Actinopyga aechinites, Holothuria scabra.

3.2 Physical-Chemical Parameters

The measurement of physics-chemical parameters of the waters in this study was conducted three times, ie morning, noon, and afternoon. Physical-chemical parameter values are taken before the sea cucumber transect is done. The parameters measured are temperature, depth, brightness, salinity, substrate, current, pH, DO, nitrate, phosphate. The value of physics-chemical parameter measurement can be seen in table 3, table 4, and table 5.

| Parameter | Piece | Station I | Station II | Station III |
|-----------|-------|-----------|------------|-------------|
| Physics   |       |           |            |             |
| Temperature | °C    | 31        | 31         | 31          |
| Depth     | cm    | 103       | 102        | 115         |
| Bright    | %     | 100       | 100        | 100         |
| Substrate |       | Sand      | Sand       | Sand        |
| Salinity  | ppm   | 32        | 33         | 29          |
| Current   | m/s   | 0.58      | 0.46       | 0.55        |
| Velocity  |       |           |            |             |
| Chemical  |       |           |            |             |
| pH        |       | 8.05      | 7.92       | 7.99        |
| DO        | mg/l  | 5.5       | 5.1        | 5.3         |
| Nitrate   | mg/l  | 4.6       | 4.7        | 4.7         |
| Phosphate | mg/l  | < 0.03    | < 0.03     | < 0.03      |

The following is data of physics-chemical measurement result of waters at Unggeh Island of Tapanuli Tengah Regency done in the morning.
Table 4. The results of physics-chemical measurements during the day

| Parameter | Piece | Station I | Station II | Station III |
|-----------|-------|-----------|------------|-------------|
| Physics   |       |           |            |             |
| Temperature °C | 32 | 32 | 32 |
| Depth cm | 38 | 104 | 79 |
| Bright % | 100 | 100 | 100 |
| Substrate | - | Sand | Sand | Sand |
| Salinity ppm | 27 | 29 | 30 |
| Current m/s | 0.05 | 0.067 | 0.025 |
| Chemical |       |           |            |             |
| pH | 7.91 | 7.91 | 7.99 |
| DO mg/l | 4.6 | 4.7 | 5.4 |
| Nitrate mg/l | 4.6 | 4.6 | 4.5 |
| Phosphate mg/l | < 0.03 | < 0.03 | < 0.03 |

The following is the result of measurement of physics-chemical waters on Unggeh Island of Tapanuli Tengah Regency conducted at noon time.

Table 5. Physical-chemical measurement results in the afternoon.

| Parameter | Piece | Station I | Station II | Station III |
|-----------|-------|-----------|------------|-------------|
| Physics   |       |           |            |             |
| Temperature °C | 30 | 30 | 30 |
| Depth cm | 105 | 112 | 118 |
| Bright % | 100 | 100 | 100 |
| Substrate | - | Sand | Sand | Sand |
| Salinity ppm | 29 | 30 | 29 |
| Current m/s | 0.46 | 0.66 | 0.61 |
| Chemical |       |           |            |             |
| pH | 7.9 | 7.98 | 7.9 |
| DO mg/l | 5.3 | 5.6 | 5.9 |
| Nitrate mg/l | 4.6 | 4.6 | 4.8 |
| Phosphate mg/l | < 0.03 | < 0.03 | < 0.03 |

The following is data of physics-chemical measurement result of waters on Unggeh Island of Tapanuli Tengah Regency conducted at afternoon time.

Density of Sea Cucumber

The density of sea cucumber at the location of research that is at station I has a density of 0.16 ind / m², on station II has a density value of 0.12 ind / m², while at station III has a density value of 0.08 ind / m², and total density of sea cucumber at research location that is 0.36 ind / m² can be seen in table 6.

Table 6. Density of sea cucumber (ind/m²)

| Station | Number of individuals | Type of sea cucumbers | Density (ind/m²) |
|---------|-----------------------|-----------------------|------------------|
| Station I | 4 | Actinopyga milliaris, A. Aechinites, Holothuria scabra | 0.16 |
| Station II | 3 | Actinopyga milliaris | 0.12 |
| Station III | 2 | Holothuria scabra, Actinopyga milliaris | 0.08 |
| Total Density | | | 0.36 |
**Diversity Index (H'), Uniformity Index (E), Dominance Index (D)**

Based on the result of data processing of all stations, the value of the index of diversity of sea cucumber is 0.983 and has low category. For the value of uniformity is 0.895 and has a high category. While for the dominance value of 0.515 has medium category. The results can be seen in table 7.

### Table 7. Diversity Index (H'), Uniformity Index (E), Dominance Index (D)

| Index  | H'   | E    | D    |
|--------|------|------|------|
| Value  | 0.983| 0.895| 0.515|

#### 3.3 Discussion

**Physics-Chemical Parameters**

Based on the measurement of physics-chemical parameters of the waters of Unggeh Island, it is found that the temperature is around 30ºC - 32ºC. Based on the measurement of water quality parameters in the morning at 31ºC, at day time measurement the temperature has a value of 32ºC, and at the time of the afternoon measurement value of 30ºC. According to [6], that the temperature is good for the life of sea cucumbers ranging from 22ºC - 32ºC. So from the results of these statements, the water temperature range at the study site is still ideal to support the life of sea cucumbers.

Based on the measurement of physics-chemical parameters of the waters of Unggeh Island, salinity value is obtained from 27-33 ppt. On the measurement of water quality parameters, the salinity is about 29 - 33 ppt in the morning, at the time of day 3 salinity value is 27 - 30 ppt, and salinity value at the time of afternoon measurement is 29 - 30 ppt. According to [7] in [8] states that salinity is one of the factors affecting the existence and life of biota in waters, including sea cucumbers. Sea cucumbers can live in the salinity range between 29 -34 ppt. In accordance with the above statement that the salinity in the waters of Unggeh Island is still good enough for the life of sea cucumbers.

The dissolved oxygen value of DO waters on Unggeh Island ranges from 4.6 to 5.9 which is obtained from measurements at 3 stations at 3 time. Measurement of dissolved oxygen in the morning has a value of 5.1 - 5.3 mg / l, dissolved oxygen niali at day time measurement is 4.6 - 5.4 mg / l, while the measurement at the afternoon is 5.3 – 5.9 mg / l. Dissolved Oxygen (DO) is a chemical variable that has a very important role for the life of aquatic biota as well as a limiting factor for biota life. According to [9] the dissolved oxygen content is good for marine organisms is 5 - 7 mg / l. Based on the Decree of the Minister of Environment No.51 of 2004, the maximum threshold of dissolved oxygen for marine life is large from 5 mg / l. From the above statement that the value of dissolved oxygen in the waters of Unggeh Island is considered good for biota life.

**Density of Sea Cucumber**

The density of sea cucumber at the location of research is at station I has a density of 0.16 ind / m², on station II has a density value of 0.12 ind / m², while at station III has a density value of 0.08 ind / m², and total density of sea cucumber at research location that is 0.36 ind / m² can be seen in table 6. In this result the amount of cucumber density is low because the number of sea cucumber found at the time of research that is only 9 individual. This may be due to some environmental conditions that interfere with the existence of these sea cucumber organisms. Due to the existence of the tap fishing gear, as well as the location used for the manufacture of tap fishing gear that allegedly can reduce the habitat of sea cucumbers. This could be the possibility of a little sea cucumber found because few survive under these conditions. In addition, sea cucumbers are found at the time of sampling found on the sand subdivision at seagrass ecosystems. According to [10] sea cucumbers are organisms that occupy sandy substrate, because sea cucumbers are generally depository feeder that is eating anything contained in the bottom of the water.

At the time of the research location also found the existence of other organisms such as sea urchins and starfish, it can also be one factor that affects the low density of sea cucumbers in the research location. [11] suggesting the presence of crabs, sea stars, and sea urchins can be one factor in decreasing the density of sea cucumbers. Crabs and starfish are predators and pests of sea cucumbers.
or sea cucumbers. The animal likes to stick to the body of sea cucumbers so it can cause injuries to the body of sea cucumbers. If the sea cucumber can not stand the wound will become larger and cause death on sea cucumbers.

The type of sea cucumber that is of significant economic value usually occupies a goba base (lagoon) with a depth of 5 to 30 meters. While the type of sea cucumber with medium and low economic value occupies shallow areas such as seagrass beds, algal growth areas and coral reefs with a depth of less than 2 meters. Usually sea cucumbers will appear on the surface of the water base at night, especially at the time of the tide, to find food. At noon the sea cucumbers prefer to immerse themselves in the sand. Sea cucumbers generally live in clusters, the type of Holothuria scabra usually live in groups consisting of three to five tails [12]. In accordance with the above statement, the results obtained for the smallest sea cucumber density can be caused by the living habits of sea cucumbers to feed and appear on the surface of the waters at night, while the sampling time is done at three times, morning, afternoon and evening.

In addition, according to local fishermen, the least number of sea cucumbers found on the island of Unggeh is due to over fishing exploitation some time later by fishermen outside Tapanuli Tengah area. Therefore, the number of sea cucumbers that are found very little and the type of commonly found fishermen on the island of Unggeh sandfish (swallow) (Holothuria scabra) and sea cucumber gamet (Actinopyga milliaris).

**Diversity indices, Uniformity Index, Dominance Index**

From the result of research known index value of diversity ($H'$) sea cucumber is 0.983. The value of this diversity is low in the waters of Unggeh Island. Because the number of species found at the time of sampling is 3 types. According to [13], diversity includes two important things: the number of species in the community and the abundance of each species, so that the smaller the number of species and variations in the number of individuals of each species have uneven distribution, the diversity will shrink and the low biodiversity occurs communities affected by seasonal or periodic disturbances by humans and nature.

The value of uniformity index (E) in the research is 0.895. From the value shows that uniformity of sea cucumbers in the waters of Unggeh Island high, this can be caused by the spread of uneven sea cucumber species in the waters. According to [14] the uniformity index ranges from 0-1. If the uniformity index is less than 0.4 then the ecosystem is in a depressed condition and has low uniformity. If the uniformity index is between 0.4 to 0.6 then the ecosystem is less stable and has moderate uniformity. If the uniformity index is more than 0.6 then the ecosystem is in stable condition and has high uniformity.

From the research result obtained value of Dominance Index (D) sea cucumber is 0.515. According to Simpson's dominant index [5] The dominant index value ranges from 0 to 1, the greater the index value the greater the tendency of one of the dominating types, the result can be concluded that there is no dominant type.

**4. Conclusions**

From the research results can be drawn the conclusion that the number of species of sea cucumber found in the study sites are 3 types, among others Actinopyga millaris, A. Aechinites, Holothuria scabra. The value of density of sea cucumber in research that is at station I has a density of 0.16 ind / m$^2$, on station II has a density value of 0.12 ind / m$^2$, while at station III has a density value of 0.08 ind / m$^2$, and total density of sea cucumber at research location that is 0.36 ind/m$^2$.

**References**

[1] Aziz A 1997 Status Penelitian Teripang Komersial di Indonesia (Status of Commercial Sea Cucumber Research in Indonesia) Oseana 22(1): 9-19

[2] Firth F E 1974 The Encyclopedia ofa Marine Resources (New York: Van Nostrand Reinhold Company)
[3] Palomares and Pauly 2011 www.Sealifebase.org. [terhubung berkala]. http://www.sealifebase.org/summary.php [03 Agustus 2011]
[4] CRITC-COREMAP II 2009 Pemantauan Perikanan Berbasis Masyarakat (Creel) Di Kabupaten Tapanuli Tengah Tahun 2008 (Community-Based Fisheries Monitoring (Creel) In Kabupaten Tapanuli Tengah Year 2008) LIPI Jakarta
[5] Direktorat Konservasi dan Keanekaragaman Hayati Laut, Kementerian Kelautan Perikanan. 2015 Pedoman Umum Identifikasi Dan Monitoring Populasi Teripang (General Guidelines for Identification and Monitoring of Sea Cucumber Populatio) Kementerian Kelautan dan Perikanan Jakarta
[6] Sutaman 1992 Petunjuk Praktis Budidaya Teripang (Practical Guidance of Sea Cucumber Cultivation) (Penerbit Kanisius Yogyakarta)
[7] Hyman L H 1955 The invertebrate Echinodermata Vol IV (New York: Mac Graw-Hill Book Co.)
[8] Saputra D A 2001 Struktur Komunitas Teripang Holothuroidea Di Perairan Pantai Pulau Pramuka Dan Pulau Tikus Kepulauan Seribu (Community Structure Sea Cucumber Holothuroidea In Coastal Waters of Pramuka Island and Thousand Island of Pulau Seribu) Institut Pertanian Bogor Bogor p 57
[9] Gufran M H, Kordi K and Tanjung A B 2007 Pengelolaan Kualitas Air Dalam Budidaya Perairan (Water Quality Management in Aquaculture) (Jakarta: Penerbit Rineka Cipta)
[10] Bakus G J 1973 The Biologi and Ecology of Tropical Holothutians (New York: Academic Press)
[11] Hana 2011 Evaluasi Pemacuan Stok Teripang pada Habitat Konservasi Lamun Pulau Pramuka, Kepulauan Seribu, Jakarta (Evaluation of Pemetuan Stok Teripang at Habitat Conservation of Seagrass Island Scout, Kepulauan Seribu, Jakarta) Program Studi Ilmu Kelautan IPB Bogor
[12] Direktorat Konservasi dan Keanekaragaman Hayati Laut, Kementerian Kelautan Perikanan 2015 Pedoman Umum Identifikasi Dan Monitoring Populasi Teripang (General Guidelines for Identification and Monitoring of Sea Cucumber Populatio) (Jakarta: Kementerian Kelautan dan Perikanan)
[13] Odum E P 1993 Dasar-Dasar Ekologi (Fundamentals of Ecology) (Yogyakarta: Gajah Mada University Press)
[14] Junianto, Irawan D, Yandri H 2014 Studi Ekologi Teripang (Holothuroidea) Di Perairan Desa Pengudang Kabupaten Bintan Universitas Maritim Raja Ali Haji Kepulauan Riau
[15] Direktorat Konservasi dan Keanekaragaman Hayati Laut, Kementerian Kelautan Perikanan. 2015 Pedoman Umum Identifikasi Dan Monitoring Populasi Teripang (General Guidelines for Identification and Monitoring of Sea Cucumber Populatio) Kementerian Kelautan dan Perikanan Jakarta