Analysis of ecology index of demospongia class (spons) in litoral zone of Cikabodasan beach of Sancang sea nature reserve Garut district

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Abstract. This research aims to determine the Ecological Index of Demospongia Classes (Sponges) in the Litoral Zone of Cikabodasan Beach, Sancang Sea Nature Reserve. The method used in this Research is descriptive method with quantitative approach and sampling using purposive sampling techniques assisted with line transects and quadrate transects in identifying species from the Demospongia Class. The sampling process was carried out by dividing the study site into three observation stations with a distance between stations 92 m. Each station consists of three line transects with a length of 100 m with a distance between the line transects 42 m. Each transect line is placed 10 transect squares with a size of 1x1m. Based on the results of the research, Demospongia class species were sampled as many 12 species with total of 272 individuals. The highest ecological index values were found in apply sinaerophoba species with diversity index value of 0.3465, abundance index of 0.7556, evenness index of 0.1395, and dominance index of 0.0625. The lowest ecological index values are found in Haliclonacinerea and Plakortis sp with diversity index value of 0.00497, abundance index of 0.0333, evenness index of 0.0200, and dominance index of 0.0001 in each species.

1. Introduction
Sponges, phyla porifera are the oldest metazoa groups that still exist on our planet. Their continued survival in large numbers in the oceans has recently been closely linked to adaptability and the characteristics of competing environments and biota [1,2].

Sponges are sea invertebrate organisms originating from the Phylum Porifera. Sponges are included as one of the primitive animals living permanently and are filter feeders, pumping water out of their bodies and filtering particles as food [3]. The diversity of sponges in a habitat is generally determined by clear water conditions and do not have strong currents. Sponges can also be found in any different depth conditions with enough brightness to grow [4].

Several studies have been carried out through observation through the distribution of sponges and determine the structure of their communities for environmental biomonitoring purposes. In tropical waters, increased sponge density is reported to correlate with productivity and eutrophication [5].

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Research examining the Litoral Zone of Cikabodasan Beach, Sancang Sea Nature Reserve, as a place or environment of the Demospongia Class (sponge) has not been conducted. Therefore "Analysis of the Demospongia Class (sponge) ecological index in the Litoral Zone of Cikabodasan Beach, Sancang Sea Nature Reserve Garut District" is needed to determine the diversity, abundance and density and dominance of the Demospongia class (sponge) which can become a bioindicator of seawater quality and its community as an environmental biomonitoring.

Based on the description the purpose of this study is to find out:

- Demospongia class species (sponges) in the Cikabodasan Beach Sancang Sea Nature Reserve
- Ecological index values include diversity, abundance, evenness, and dominance of the Demospongia Class (sponges) in the Littoral Zone of Cikabodasan Beach, Sancang Sea Nature Reserve

The results of this study are expected to be a source of information regarding the ecological index of the Demospongia Class. That it will be very important for sustainable management on the coast in the Sancang Sea Nature Reserve to improve water quality.

2. Methods

This research was conducted in the littoral zone of Cikabodasan Beach, Sancang Sea Nature Reserve of Garut district in April-May 2019.

The sampling technique of this study was using a purposive sampling technique. The method used to identify species from the demospongia class is the line transect method and the quadratic transect.

The research site was divided into three stations with 92 m distance between stations and each station consisted of three transect lines with a length of 100 m that extends offshore at each transect line and the distance between transect lines is 46 m wide. on each transect line there are 10 quadratic transects with a width of 1x1 m² with a distance on each transect squared 10m.

The population used is all types of animals that belong to the class Demospongia in the littoral zone of Cikabodasan Beach, Sancang Sea Nature Reserve Garut.

The samples used were individuals from the Demospongia class found in the littoral zone of the Cikabodasan coast of the Sancang Sea Nature Reserve by sampling using the Line Transect and Square Transect methods.

Collecting data in this study using observation techniques. After observing the data, it will be calculated using the formula below.

a. The level of diversity of sponges present in the observation station can be determined using the Shannon-Wiener diversity index formula [4,6].

$$H' = - \sum_{i=1}^{s} P_i \ln P_i \text{ with } P_i = \frac{N_i}{N}$$

Information:
H' = Shannon-Wiener diversity index, $P_i = n_i / N$ (i-th proportion), $N_i$ = Number of I-type individuals, $N$ = Total number of individuals of all types Shannon diversity index range is categorized based on values as follows [3]: $H' > 3$ = high, $1 \leq H' \leq 3.0$ = moderate, and $H' < 1$ = low

b. The abundance of individuals can be expressed as the number of individuals of broad union. The abundance is calculated by the formula:

$$A = \frac{X_i}{ni}$$

Information:
A = Abundance (individual / m²), $X_i$ = Number of individuals (individuals), $ni$ = Area of I-type plot found (m²)
c. The evenness index shows the distribution pattern of biota, which is evenly or not. If the evenness index value is relatively high, the existence of each type of biota in the waters is evenly distributed \[7\].

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

Information:
E = evenness index, H' max = \(\ln s\) (s is the number of types), H' = diversity index
Index values range from 0-1, E = 0, evenness between low species, and E = 1, evenness between species is relatively evenly distributed

d. The dominance of certain species can be determined by using Simpson Dominance index \[8\].

\[
D = \sum_{k=0}^{n} (P_i)^2 = \sum_{i=1}^{n} \left(\frac{N_i}{n}\right)^2
\]

Information:
D = Index of dominance, \(N_i\) = Number of individuals of the 1st species, \(N\) = Total number of individuals, \(S\) = number of species
Index values ranged from 0-1 = 0 < C < 0.5 = no genius dominated, 0.5 < C < 1 = a dominant genus

3. Results and discussion

3.1. Research results

3.1.1. Aquatic environmental factor parameters. The parameters of aquatic environmental factors measured include biotic and abiotic factors. Biotic factors sought are the availability of feed in the form of plankton for sponges. As for those caught by the plankton net include Phytoplankton and Zooplankton. Zooplankton found are from the order of Copepoda (Paracalanus, Eutheurpin, Daphnia, Harpacticoida, Candida, Copilia, Corucaeus), Euplotes, Phacus, Loxodes, hemisiella parva, Holophyra teres, Lacrymatoria, Pseudoephasia latifrons, Actinos. Phytoplankton found in diatomic algae, Coscinodiscus, Nitzchia, Rhizosolenia, Cyanobacteria (Oscillatoria), Porticella. A comparison of the measured abiotic factor parameters can be seen in the table below.

| No | Abiotic Factor              | Station 1 | Station II | Station III |
|----|-----------------------------|-----------|------------|-------------|
| 1  | Air temperature \((^\circ \text{C})\) | 26.87\(^\circ\)C | 26.88\(^\circ\)C | 27.03\(^\circ\)C |
| 2  | Salinity (ppt)              | 31.81 ppt | 31.17 ppt | 30.66 ppt |
| 3  | Brightness (cm)             | 15.41 cm  | 19.83 cm  | 14.93 cm  |
| 4  | Humidity (%)                | 76.94%    | 77.38%    | 74.66%    |
| 5  | Light intensity (lux)       | 702.67 x 100 lux | 726.86 x 100 lux | 789.8 x 100 lux |
| 6  | Wind Speed (km/jam)         | 4.37 km/jam | 4.18 km/jam | 2.37 km/jam |
| 7  | pH Water                    | 6.89      | 6.95      | 7.09      |

Based on the results of abiotic factor measurements at the Cikabodasan coast of the presumptuous sea nature reserve showed that for the water temperature factor ranging from 26 – 27 °C, salinity ranged from 30 ppt - 31 ppt, brightness ranged from 14 cm - 19 cm, humidity ranged from 74% to 77%, light intensity ranges from 702.67x100 lux-789.8x100 lux, wind speed ranges between 2 km/h - 4 km/h and water pH ranges from 6-7.
3.1.2. **Species from the Demospongia Class found in the Litoral Zone of Cikabodasan Beach, Sancang Sea Nature Reserve, Garut District.** Animals from the demospongia class (sponges) found on the cikabodasan coast of the sea preserve can be seen in the Table below.

**Table 2.** Demospongia class species data found.

| No | Class          | Ordo       | Family     | Species                  |
|----|----------------|------------|------------|--------------------------|
| 1  | Demospongia    | Spirophorida | Tetillidae | Cinachyrella sp          |
| 2  | Hadromerida,   | Clionaidae | Clionaidae | Cliona varians         |
| 3  | Verongida      | Aplysinida | Aplysinida | Aplysina aerophoba       |
| 4  | Subericide     | Halichondriida | Halichondriida | Epipolasis tubulata |
| 5  |               |            |            | Haliclona sp            |
| 6  |               | Haplosclerida | Chalinidae | Haliclona magnifica   |
| 7  |               |            |            | Haliclona cinerea       |
| 8  | Homosclerophorida | Plakinidae | Plakortis sp |
| 9  | Dictyotertatida | Spongiidae | Spongia stuposa |
| 10 |                | Irciniidae | Ircinia sp |
| 11 |                | Axinellidae | Axinella sp |
| 12 | Halichondrida  |            | Halichondrida | Halichondria sp |

Based on the table above, species from the demospongia class found at three stations numbered 8 orders, 10 families and 12 species. The orders found were the Spirophorida, Hadromerida, Verongida, Subericide, Haplosclerida, Homosclerophorida, Dictyotertatida and Halichondrida Orders. While the families found at three stations are from the Tetillidae, Clionaidae, Aplysinidae, Halichondriidae, Chalinidae, Plakinidae, Spongiidae, Irciniidae, Axinellidae and Halichondriidae families. For species found include Cinachyrella sp, Cliona varians, Aplysina aerophoba, Epipolasis tubulata, Haliclona sp, Haliclona magnifica, Haliclona cinerea, Plakortis sp, Spongia stuposa, Ircinia sp, Axinella sp and Halichondia sp.

**Figure 1.** Recapitulation chart of species of Demospongiae class taken at 3 scrap stations (number of individuals).

Based on the data above, it can be seen that for species from the demospongia class found at three stations there are 12 species from the demospongia class with a total of 272 individual individuals at the three stations. The most number found in the station I with the number of species found in nine species and the number of individuals reached 116, station II found 12 species with a total of 76 individuals, while station III found 11 species with a total of 80 species of individuals.
The species most commonly found at three stations is Aplysina aerophoba with a total of 68 individuals, and the fewest species found are Plakortis sp and Haliclona cinerea with a total of 3 individuals in each of these species.

Diversity, Abundance, Evenness and Dominance Index Value, after obtaining the number of species at each station, then data analysis is performed to determine the diversity index value, abundance, evenness, and dominance.

3.2. Discussion

Based on field observations, 12 species of demospongia species have been identified. Of the 12 species included in nine orders and 11 families with a total number of individuals as much as 272 individuals. From 272 individuals, Aplysina aerophoba species amounted to 68 individuals, Epipolasis tubulata numbered 52 individuals, Cliona variance numbered 34 individuals, Spongia stuposa numbered 31 individuals, Haliclona magnifica numbered 30 individuals, Cinachyrella sp totaling 16 individuals, Haliclona sp totaling 13 individuals, Ircinia sp totaling 12 individuals, Axinella sp. and Halichondria sp. each of which consists of five individuals, Haliclona cinerea and Plakortis sp. each of which consists of three individuals.

The most commonly found species are Aplysina aerophoba with 68 individuals. That is because Aplysina aerophoba is one of the species of the demospongia class that is able to survive with the abiotic environmental conditions around the Litoral Zone of Cikabodasan Beach, Sancang Sea Nature Reserve.

Environmental conditions at Cikabodasan beach are good environmental conditions for the growth of Aplysina aerophoba. According to the Aplysina sponge type is dominant in the flat reel zone. According to research [2], Aplysina types abound in exposed locations at depths of 5 to 15 m. It is indicated that this species will be more often found in low coastal zones and with mud substrate and attached to rocks but not infrequently these species are able to live in deep waters. This is in accordance with the environmental conditions of the study site because along the littoral zone there are no sloping places, other than that the type of substrate on the cikabodasan coast of the sea preservation is muddy sand. This causes more species to be found compared to other species at the study site.

The species from the demospongia class that was found the least was Plakortis sp. and Haliclona cinerea. For species of Plakortis sp. According to Ubare et al., [9] states that this species lives in all areas that have rocky bottom and stick to the rock outcrop, this sponge is also surrounded by coral morphs, algae, ascidia and coral. In this study, in the vicinity of the study site, there was no habitat found that could be symbiotic with this species. In addition, the type of substrate at the study site is sandy mud and it is very rare to find rock outcrops that are habitats of this species in general so that it causes little to find this species at the study site.

According to other studies, Haliclona sp. is a sponge that has a high tolerance to extreme oceanographic conditions. But because of the activity of fishermen and tourists who accidentally stepped on a sponge, causing the number of species Plakortis sp. or Haliclona cinerea is reduced.

Salinity measurement results at the Cikabodasan Beach Sancang Sea Nature Reserve conducted at three stations show values that are not much different at the three stations with measurement results between 30-31 ppt. This figure is still within normal limits for sponge growth, as Yasakti [10] state that sponges live in the range of the 30-38 salinity range and are more sensitive to low salinity. The distribution of salinity in the sea is generally influenced by factors such as the pattern of water circulation, evaporation, rainfall, and water flow.

The highest index value of sponge species diversity was Aplysina aerophoba species with a diversity index value of 0.3465. This happens because the species Aplysina aerophoba is one of the most numerous species found at the study site. In addition, habitat conditions on the cikabodasan coast of the sea preserve are designed to support the survival of Aplysina aerophoba sponges. However, the diversity index value obtained is low. This happens because of human activities that cause disturbance of habitat conditions around the cikabodasan beach so that it affects the survival of sponges.

The lowest index value of species diversity of sponges was Plakortis sp. and Haliclona cinerea with diversity index values in each type of 0.0497. This happens because these two species are the fewest
species found at the study site because the habitat conditions on the coast of Cikabodasan designed sea nature reserve is less supportive for the survival of this species. The habitat condition of cikabodasan beach is muddy sand. according to Ubare et al., [9] states that this species lives in all areas that have a rocky bottom and attaches to the rock outcrop, this sponge is also surrounded by coral morphs, algae, ascidia and coral.

The number of individuals from the demospongia class found in the littoral zone of the cikabodasan coastal sea preserve was 272 individuals from 12 species of sponges with a diversity index value of 2.1095 included in the medium category. Obtained seven types of demospongia classes with a total number of individuals 256 and an index value diversity obtained is 0.3327 which is included in the low category. Therefore, because the total number of species found in this study is 12 species, the diversity index value category produced is moderate. According that, the more species or genus in a sample, the greater the diversity index value even though this value is highly dependent on the total number of individuals of each type.

The low value of the evenness index occurs due to the imbalance of the ecosystems that exist on the Litoral Zone of Cikabodasan Beach, Sancang Sea Nature Reserve. That is due to human activities around spongy habitats that disturb ecosystems on the Cikabodasan Beach, Sancang Sea Nature Reserve. This is evidenced by not always finding a sponge in every observation transect.

4. Conclusion
Species that dominate the spongy community structure will cause high competition among types of sponges, this will cause disruption of other types of sponges so that ecologically other sponges that do not dominate with 272 individuals namely Aplysina aerophoba species 68 individuals, Epipolasis tubulata 52 individuals, Cliona variance 34 individuals, Spongia stuposa 31 individuals, Haliclona magnifica 30 individuals, Cinachyrella sp. 16 individuals, Halicloana sp. 13 individuals, Ircinia sp. 12 individuals, Axinella sp. and Halichondria sp. five individuals, Haliclona cinerea and Plakortis sp.

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