Spatial and Temporal Habitat of Lobster Seeds (Panurilus Spp.) in the Spelman Strait Waters, Indonesia

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Abstract

The purpose of this study was to determine the spatial and temporal characteristics of the lobster habitat. This research was carried out from September to December 2021. The research location was deliberately carried out in the waters of the Spelman Strait, Central Buton Regency, the location for catching lobster seeds in sand, mud, and coral rubble habitats. The method for analyzing the similarity of lobster seed species using the Sorensen Similarity Index formula which is based on the presence and absence of a lobster seed species with other species at each station and the long-weight relationship, calculated using the formula W=αLb to determine the equation b<3 or negative allometric. The results showed that spatially and temporally, there were 412 individual lobster seeds in each habitat, namely Panurilus. ornatus and P. versicolor. The highest presence of lobster seeds was found in the mud habitat with 177 individuals, followed by the coral rubble habitat with 127 individuals, and the mud habitat with 106 individuals. 316 individuals of P. ornatus lobster seeds and 94 individuals of P. versicolor. The results of binary index testing for each habitat showed that P. ornatus and P. versicolor were found in all habitats with group A (habitat of rubble) and group B (habitat of mud and sand). habitat characteristics. Spatially and temporally, P. ornatus and P. versicolor in the Spelman Strait showed growth that was negative allometric (b<3), where the increase in length was faster than the increase in weight. The R2 value or determination is close to 100%, where the sand habitat is (92%), the difference is (8%), the mud habitat is (90%), the difference (10%) and the coral rubble habitat (is 91%), the difference is (9%), meaning that the weight growth is affected by the increase in length, while the difference is influenced by the habitat. The existence of P. ornatus and P. versicolor lobster seeds needs to be maintained to maintain the sustainability of lobster seeds in the waters of the Spelman Strait.

Keywords: lobster seeds (Panurilus spp.); spatial; temporal

1. Introduction

In Lobsters are crustaceans and live in water all their lives. Lobsters are invertebrate animals belonging to the Phylum Arthropoda that live in water (Robles, (2007). Habitat characteristics are favorite places for marine organisms. Lobster (Panurilus spp.) habitat generally lives on coral reefs. Panulirus hommarus is usually found living in coral waters at a depth of tens of meters, in granite or volcanic rock holes. This species is often found in large

groups. When young, Panulirus hommarus is more tolerant of murky waters. After reaching adulthood, it prefers clear waters with a depth of 1-5 meters (Kanna, 2006).

Many lobsters (Panulirus spp.) live in coastal and strait waters. Indonesia is an archipelagic country, so in almost all waters there is a population of lobsters. Some researchers report that the largest populations start from the waters of Sumatra (Lampung), West Java (in Pangandaran), East Java (in Tawang and Kili-Kili Bay), West Nusa Tenggara (in Gerupuk Bay (Amin *et al*., 2022; Priyambodo *et al*., 2020; Mukhtar *et al*., 2021; and Priyambodo *et al*., 2015). Kanna (2006), and also reported by Setyagama *et al*., (2023) stated that the distribution of lobsters in Indonesia, there are several regions such as West Sumatra, South Java, Bali, Nusa Tenggara, Sunda Shelf, Malacca Strait and East Kalimantan, South/West Kalimantan, East Sumatra, North Java, Sulawesi, Maluku and Papua.

Since 2005, lobster has been one of the export commodities in the fisheries sector, ranking fourth for crustacean export commodities after the genera Penaeus, Metapeaneus, and Macrobrachium (Junaidi *et al*., 2010). General demand for Indonesian Lobster comes from Asian countries (Japan) including Southeast Asia where Vietnam is the largest (Setyagama *et al*., 2023).

Lobster catching in Indonesia generally uses drums, placed in sand, mud and coral rubble habitats. Ayodhyoa (1981); and Baihaqi *et al*., (2021) tates that bagang is a fishing gear that uses light as a tool to attract and collect fish in the fishing gear coverage area, making it easier to catch. This method is generally used by small (traditional) fishermen.

One of the areas with lobster habitat in Sulawesi is in the waters of the Spelman Strait, located in Central Buton Regency to the Tiworo Strait in the northern part of West Muna (Southeast Sulawesi Province) to the western part of the Bone Strait, and the southern part of the Flores Sea. Lobsters caught in the waters of the Spelman Strait are generally mature and seed-sized lobsters. Seed size lobsters are widely caught in various habitats.

However, there is limited data and information regarding population and lobster seeds in the Spelman Strait area. On this basis, the study presents the spatial and temporal characteristics of the clear lobster seed habitat in the Spelman Strait with a focus on locations in the Central Buton Regency area.

2. Research Methodology

Time and Location of Research

This research (data collection and processing) was carried out from September 2021 to December 2021. The research sites were divided into sand, mud and coral rubble habitats. This research was carried out in the waters of the Spelman Strait, Central Buton Regency, Southeast Sulawesi Province (Figures 1 and 2), the location where lobster seeds live.

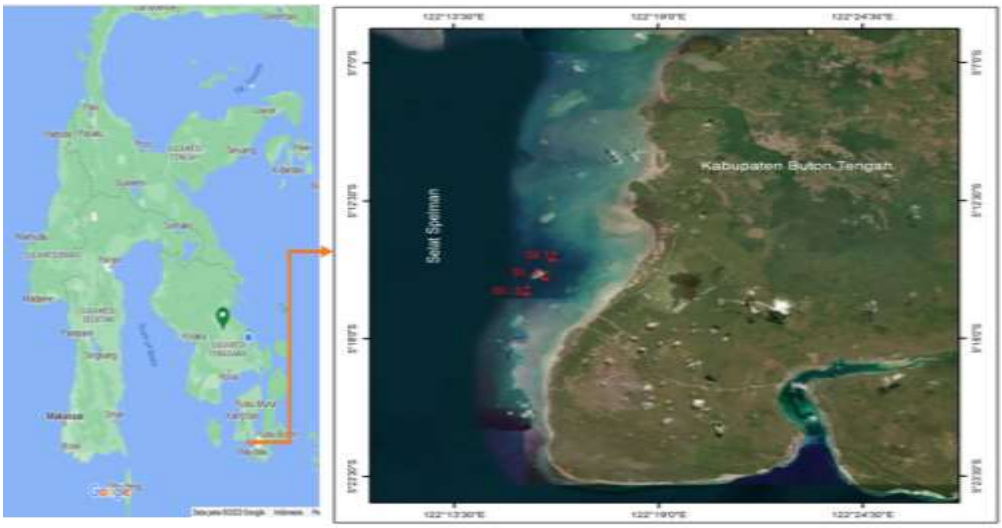

Figure 1. Map of Research Locations

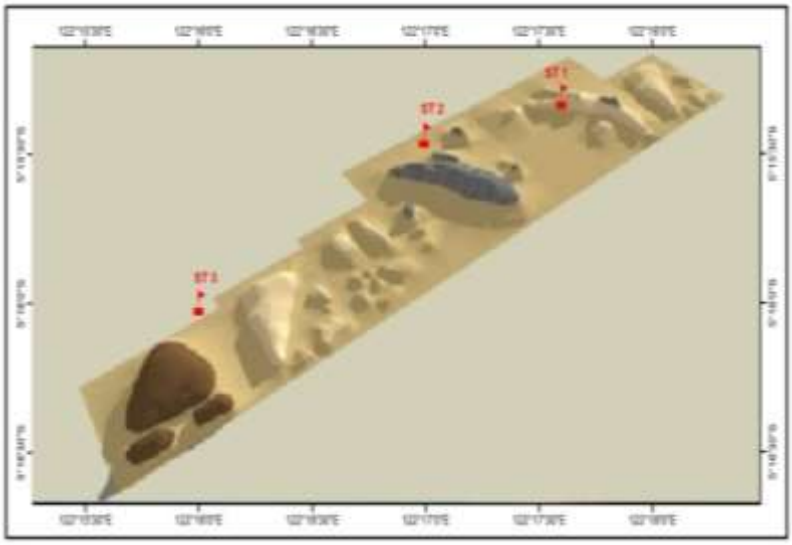

Figure 2. Habitat Characteristics Map of Mud Sand snd Coral Rubble***Sampling Technique***

Sampling of lobster seeds using bagang drum fishing gear (Figure 3) placed in different habitats. Bagang apung Bagang drum has a size of 11x12 m, equipped with a black net with a hole size of 3 mm as a trap for lobster seeds. The light uses a motoyama SPG 3800 E1 generator (2500 watts). The bulb used is a 40 watt Philips brand led bulb.

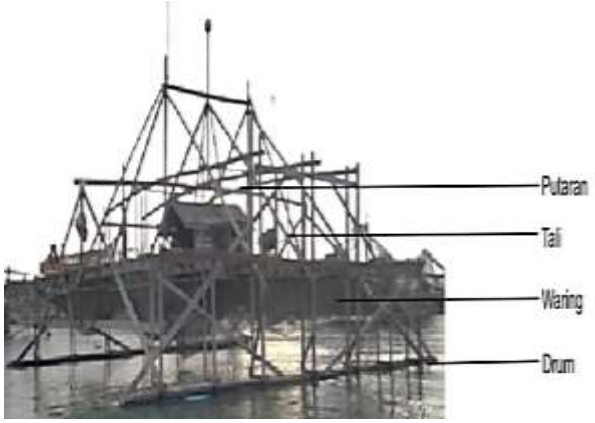

Figure 3. Drum Bagang Fishing Gear

Catching lobster seeds, namely bagang drums which are placed in the habitat of sand, mud and coral rubble, at 18.00, the generator is turned on, the waring is lowered to the bottom of the water surface at a depth of 5-15 m, at 20.00 WITA the waring on the surface is then lifted using a spin, equipped with a rope as a connecting link. After the waring rises above the bagang, the lobster seeds are caught using a bundre with a mouth diameter of 30 cm, the height of the waring bag is 60 cm, and the length of the handle made of bamboo is 4 m. Lobster seeds in the bundre are then put into a 75D x 41x31 cm Styrofoam container filled with water and given an aquela brand erator with 2 holes, equipped with a 3/6 hose and 2 pieces of 3mm aeration stones. After completion, the waring is lowered back to the bottom of the sea until 05.00 WITA. In the morning the lobster seeds stored in Styrofoam were then unloaded into a 6.5 m long, 2 m wide speedboat using 2 Parsun outboard engines with a capacity of 40 hp. After arriving at the observation site, measurements of length, weight and other identification were carried out. Sampling of water quality was carried out simultaneously in situ.

Data Analysis

Observations of habitat characteristics were analyzed using the Canbera formula and the Similarity formula. Habitat similarity was analyzed using the Canbera Index by Lance and William (Moreau and Legendre, 1979) with the formula:

Canbera:

$$Ic = \frac{1}{n} \frac{2W}{A + B}$$

Where:

Ic: Cambera Index (0 - 1) or (0 - 100%)

A: Data value of the Ith parameter from the j-th station

B: Data value of the (i + 1) parameter of the jth station (j + 1)

W: The smallest value between A and B

n: Number of calculated components.

Similarity:

Then proceed with an analysis of the similarity of lobster seed species using the Sorensen Similarity Index formula (Legendre & Legendre, 1983), which is based on the presence and absence of a species of lobster seed with other species in each habitat, with the formula:

$$Is = \frac{2a}{2a + b + c}$$

Where:

Is: Sorensen similarity index

a: Frequency of the existence of the i-th and j-th species

b: Frequency of existence of species i-th only

c: Frequency of occurrence of the j-th species only

To know the preference of habitat for each species of lobster seed to habitat, a Nodal analysis is used which is based on the index of consistency and fidelitis. In this analysis, the

similarities between habitats were first assessed based on the physico-chemical parameters of the water.
Similarities between habitats are examined using the Cambera Index (Moreau and Legendre, 1979) with the following formula:
Constance,
Constancy analysis is used to analyze the constancy level of lobster seeds in certain habitats with the following formula:

$$Cij = \frac{aij}{ni\ nj}$$

Where:
Cij = Consistency Index
aij = Number of lobster seeds found at the j-th station
ni = Number of lobster seeds
nj = Number of lobster seeds at the j-th station

Fideliti,
The Fideliti Index value for each matrix component (La Sara and Asriyana, 2012), the formula is:

$$F_{ij} = \frac{C_{ij}}{\frac{\sum jaij}{ni \sum nj}}$$

Where:
Fij; Fideliti Index
Cij: Consistency Index
aij: Number of lobster seeds in type I at station j
nj: Number of lobster seeds at the jth station
ni: Total number of lobster seeds

Seed Weight Length Relationship,
According to (Effendi, 2003), the analysis of the long-weight relationship is calculated using the equation:

$$W=\alpha L^{b}$$

Where:
W: Body weight (grams)
L: Carapace length (mm)
a: constant or intercept
b: exponent

3. Result

Existence of lobster seeds Spatially and Temporal

The results of the study of spatial and temporal characteristics of the habitat can be seen in (Table 1), the presence of a total of 412 individual lobster seeds, there were 2 types of lobster seeds, namely P. ornatus and P. versicolor. The highest presence was found in mud habitat with 177 individuals, followed by rubble habitat with 127 individuals and sand habitat with 106 individuals.

Table 1. Spatial and Temporal Presence of Lobster Seeds in Each Habitat

Habitats	Month				Total
	Sep.	Oct.	Nov.	Dec.	
Sand	13	39	28	27	107
Mud	30	59	46	41	176
Coral Fragments	25	43	36	25	129

The presence of lobster seeds from September to December for each species (Table 2) was 412 individuals, P. ornatus lobster seeds were 316 individuals and P. versicolor 94 individuals.

Table 2. Spatial and temporal presence of lobster seeds for each species

Habitats	Species		Total
	P. ornatus	*P. versicolor*	
Sand	72	34	106
Mud	154	23	177
Coral Fragments	90	37	127

Spatial and Temporal Characteristics of Lobster Seed Habitat

The results of the analysis of the characteristics of the lobster seed habitat using the Canberra index can be seen in Table 3.

Table 3. Results of the Canbera Index Test using Habitat Grouping

Habitats	Sand	Mud	Coral Fragments
Sand	-	-	-
Mud	98,75 %	-	-
Coral Fragments	89,04 %	90,30 %	-

Based on the results of the Canbera Index test using a matrix of lobster seed habitat grouping, it can be seen in Table 2. The different habitat studies of the Canbera Index values for mud-sand habitat were 98.75%, coral-sand rubble habitat was 89.04%, and coral rubble habitat - sludge is 90.30%.

Table 4. Binary Index Test Results Using the Lobster Seed Matrix Binary

Species	Habitats		
	Sand	Mud	Coral

			Fragments
P. ornatus	1	1	1
P. versicolor	1	1	1

The results of the Canbera Index analysis using a dendogram for grouping habitats into two groups can be seen in Figure 4. The results of the Binary Index Test using the Lobster Seed Binary Matrix are in Table 4.

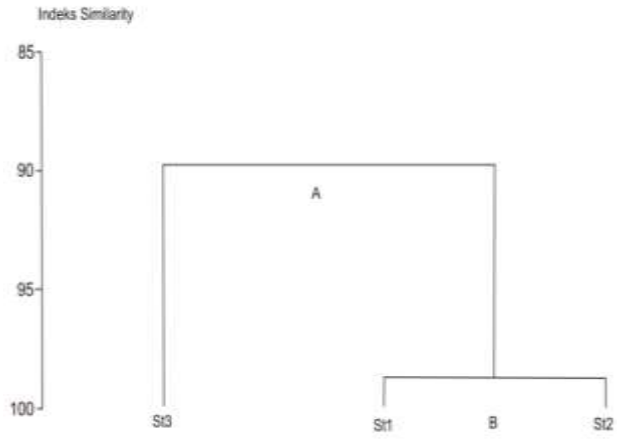

Figure 4. Station Classification Dendogram in the Spelman Strait Waters

Spatial and Temporal Weight Length Relations

Based on the results of testing the long-weight relationship for each habitat (Table 2). The correlation between the suitability of lobster seeds and the habitat of sand, mud and coral rubble was obtained. The number of lobster seeds measured in the sand habitat was 106 individuals consisting of 72 individual P. ornatus lobster seeds and 34 individual P. versicor lobster seeds, 177 individual mud habitats, consisting of 154 P. ornatus seeds and 23 P. versicolor individuals, and 127 individuals of coral rubble habitat, 90 individuals of P. oranutus and 37 individuals of P. versicolor.

Graph of the relationship between the length of the lobster seed weight and the sandy habitat (Figure 5), the value b = 1.28 <3, meaning that the allometric is negative, where the growth in length is faster than the growth in weight, the R2 value or determination value is 0.92 or 92% , weight growth is affected by length growth, while 8% is affected by sandy habitat.

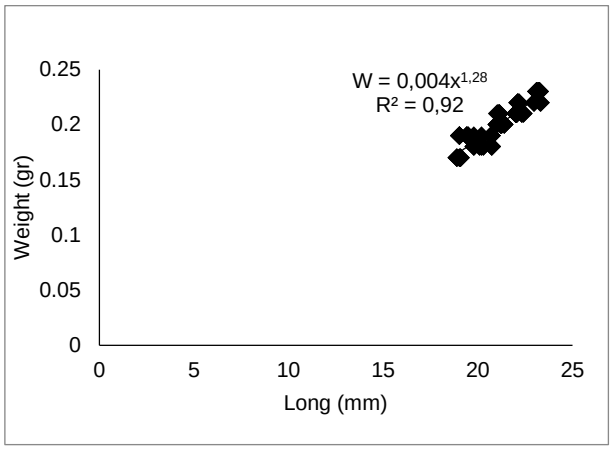

Figure 5. The relationship between the length and weight of the sand habitat

Graph of the relationship between the length of the lobster seed weight and the mud habitat (Figure 6), the value b = 1.31 <3, meaning that the allometric is negative, where the growth in length is faster than the growth in weight, R2 value or a determination value of 0.90 or 90% weight growth is affected by length growth, while 10% is influenced by mud habitat.

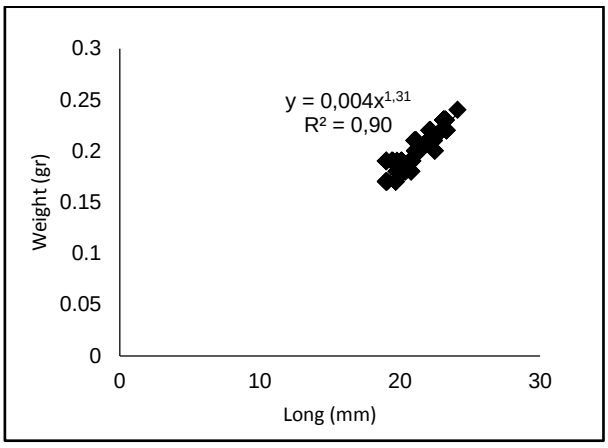

Figure 6. Long-weight relationship to mud habitat

Graph of the relationship between the length of the lobster seed weight and the coral rubble habitat (Figure 7), obtained the value b = 1.27 <3, meaning that the allometric is negative, where the growth in length is faster than the growth in weight, R2 value or a determination value of 0.91 or 91 % weight growth is affected by length growth, while 9% is affected by mud habitat.

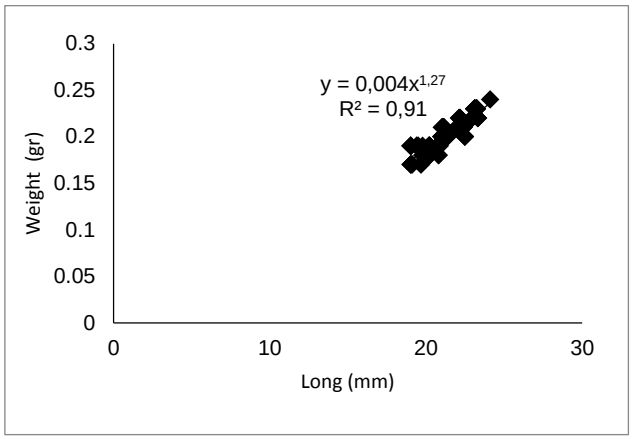

Figure 7. The relationship between the length and weight of the coral rubble habitat

Water Quality Parameters

The results of water quality measurements at research stations, including temperature, current speed, brightness, salinity, TSS and Dissolved Oxygen (DO) can be seen in Tables 5 and 6.

Table 5. Water Quality Parameter Values in the Spelman Strait waters in the east monsoon

Parameters/Unit	Average result of measurement/analysis		
	St.1	St.2	St.3
Temperature (^{0}C)	29	29	29
Salinity (ppt)	31	31	31
Brightness (m)	8	7	7
pH	8	8	8
DO (mg.L)	7,4	7,3	7,4
Current speed (m/s)	0,07	0,07	0,07

Water Quality Parameter Values in the Spelman Strait Waters in the West Season are presented in Table 6,

Table 6. Water Quality Parameter Values in the Spelman Strait Waters in the West Monsoon

Parameters/Unit	Average result of measurement/analysis		
	St.1	St.2	St.3
Temperature (^{0}C)	30	30	30
Salinity (ppt)	31	31	31
Brightness (m)	4,8	4,5	4,0
pH	8	8	8
DO (mg.L)	7,4	7,3	7,4
Current speed (m/s)	0,02	0,2	0,2

4. Discussion

Habitat Characteristics

Habitat characteristics of each habitat (spatial) and month (temporal) as a whole were 412 individuals, there were 2 types of lobster seeds namely P. ornatus and P. versicolor). The highest presence of lobster seeds was found in mud habitat with 176 individuals, coral rubble habitat with 129 individuals and station 1 with 107 individuals. Based on Fazrul *et al*., (2015) the abundance of bycatch in Pattani Bay is influenced by habitat, season and interactions between habitat and season, while the number of species per sampling is only affected by seasonal changes, but in this study season and location affect lobster seed species. Catching lobster seeds using Bagang Drum can affect the number of catches because it is not selective (Eayers, 2007; and Raesi *et al*., 2012). The less selective the fishing gear, the higher the composition of bycatch produced, such as trowl nets (Harrington *et al*., 2012; Paighambari & Daliri, 2012; Hosseini *et al*., 2012; and Raeisi *et al*., 2012).

Based on Figure 4. Habitats are divided into two groups, namely sand and mud into group B, coral rubble into group A, mud-sand habitat, namely 98.75%, coral-sand fragments habitat, namely 89.04%, this happens because it has ecological similarity and station 3-2 is 90.30%. Combining the results of grouping similar types of lobster seeds with similar characteristics of the habitat, two types of lobster seeds were grouped, namely P. ornatus and P. versicolor lobster seeds found at different stations with a 100% similarity level. The similarity of environmental conditions for marine biota can affect the life of marine biota. Arqam *et al*., (2019) that coral reefs are a habitat for various types of fish and other marine biota because they have water fertility, spawning grounds and breeding grounds for marine biota.

Long Weight Relationship to Habitat

Growth is determined based on the b value obtained from the equation of the long relationship to the weight of the lobster seeds. The b value of each study shows a difference in magnitude even though it has the same growth pattern (Graphs 5, 6 and 7). The difference in the value of b obtained generally occurs in different spatial and temporal terms. The difference in the value of b shows the length-weight relationship caused by ecological and biological conditions (Manik, 2009). Ecological conditions include season, water quality, temperature, pH, salinity, geographical position and sampling technique (Zargar *et al*., 2012; and Jenning *et al*., 2001). Biological factors include: gonad development, feeding habits, growth phase and species gender (Froese, 2006; and Tarkan *et al*., 2006). Changing environmental conditions can cause organisms to change so that the length-weight relationship will deviate from the cubic law (Merta, 1993).

According to Mulfizar *et al*., (2012) relative weight (Wr) and coefficient (K) of environmental conditions are used to evaluate the condition value of each individual. The observed average weight value (W) is lower than the predicted average weight value (Ws) or the relative weight (Wr) is less than 100 which can indicate that the waters are less supportive for growth. Availability of food is one of the things that affect the balance of the habitat. P. ornatus and P. versicolor consume bivalves as the main food; crabs, gastropods, barnacles and algae as side dishes. While fish, Echinodermata and Ascidiacea are additional food if the main and side food is not found (Mashai *et al*., 2011).

According to Rao *et al*., (2010) the availability of sufficient food ingredients can accelerate the growth rate of lobsters. The weight growth of sand lobsters is 0.45% per day in rearing tanks and 0.5% per day in the sea. In addition to the availability of food, environmental factors are also a matter that influences the growth and condition of lobsters. Lobsters live in areas with characteristic rocky sand beaches (Pratiwi, 2013) and on coral reefs (Saudi *et al*., 2011). Lobsters have the nature of living by immersing themselves during the day and actively eating at night (nocturnal) (Setyono, 2006). P.*homarus* lobster species can live in association with P. penicillatus species (Saudi *et al*., 2011).

Water Quality Parameters

The temperature of the waters at all observation stations, both the west monsoon (strong winds) and the east monsoon (shady waters) ranges from 29 – 30°C. Water temperature is a limiting factor for habitat. Based on quality standard criteria, the water temperature in the Spelman Strait waters is as required by the Lobster seed habitat. the most optimal temperature ranges from 25 - 28°C. Muqsit *et al*., (2016), the temperature of the waters on Dua Island, Enggano District ranges from 28.6°C -29.30°C. However, it can still tolerate temperatures in the range of 20°C, up to 36 – 40°C (Nybakken, 1992).

Salinity at all observation stations is at 31% salinity. The condition of the land facing the Spelman Strait is not affected by rivers, or the presence of industry and other activities, so the condition of the waters of this strait is still natural. The optimum salinity for coral life ranges from 30–33%. Supriharyono, (2007) the appropriate salinity for coral growth and formation ranges from 27-40%.

The brightness of the waters greatly affects the life of aquatic ecosystems in the process of photosynthesis by zooxanthellae. The brightness of the waters of the observation area at Station 1 (8 m), station 2 (7 m), and Station 3 (7 m), was measured during the east monsoon (not strong winds) while measuring the brightness of the waters at Station 1 (4.8), station 2 (4.5 m), station 3 (4.0 m) during the west monsoon (strong winds). According to Maharbhakti, (2009) clear waters have a high brightness value that affects the growth of coral reefs, especially Zooxanthellae in carrying out the photosynthesis process. The range of acidity (pH) at each research station is 8. This pH range is the optimal pH for coral growth. This is in accordance with the quality standard by the Indonesian Minister of Environment No. 51 of 2004, the optimal pH for coral growth is between 7 - 8.5. Muqsit *et al*., (2016) in the waters of Pulau Dua, Enggano District, the pH range is an average of 8. Measurement of current velocity in the west season (strong winds), the highest occurs at station 1 (0.02 m/s-1), and the lowest current at station 4 (0.07 m/s). s-1) (Table 6). The condition of the waters on the coast of the Spelman Strait from September to December is relatively calm. According to Suharsono, (2008), the optimal current speed for water is 0.05 m/s-1 - 0.08 m/s- 1. Ikhsan *et al*., (2013) current velocity that supports the growth of Acanthaster planci coral in the waters of Bero Island, Tiworo Strait, Southeast Sulawesi ranges from 0.07 – 0.50 m/s-1 Overall current velocity at each research station there is not much difference, and it is the quality of the waters that supports the life of coral reefs.

Dissolved Oxygen (DO) at the observation stations varied enough, ranging from 7.3 to 7.4 mg/l. at all data collection stations, the DO values obtained indicated that the waters were in very good condition, and still met the seawater quality standards in the Ministry of

Environment No. 51 of 2004 for marine biota with DO values >5 mg/l, so DO concentrations in the coastal waters of the Spelman Strait are still classified as suitable for marine biota to support their life, where at each observation station they still meet quality standards. The abundance of organisms in the Bedukang waters of Bangka Regency has a positive correlation with environmental parameters, namely dissolved oxygen, ranging from 6 - 7.7 mg/l (Fatimah *et al*., 2017). BOD5 at all stations, both in the west monsoon (strong winds) and east monsoon (shady waters) ranges from 3.7 – 6.2 mg/l.

5. Conclusion

The presence of lobster seeds from September to December as a whole was 412 individuals, there were 2 types of P.*ornatus* and P.*versicolor*. The highest presence was found in the mud habitat with 177 individuals, followed by the rubble habitat with 127 individuals, and the sand habitat with 106 individuals. 316 individuals of P.*ornatus* lobster seeds and 94 individuals of P. Versicolor.

Spatially and temporally in the Spelman Strait, P.ornatus, and P.versicolor showed growth that was negative allometric (b<3), where the increase in length was faster than the increase in weight. The R2 value or determination of Station 1 (sand habitat) is 92%, station 2 (mud habitat) (90%), and Station 3 (coral rubble habitat) (91%) is close to 100%, meaning that weight growth is influenced by length gain, while 8 % station 1, 9% station 2 and 10% station 3 are affected by habitat.

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