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DISTRIBUTION OF SOFT CORALS OF THE ALCYONIIDAE FAMILY IN THE FORE REEF ZONE ON BARRANGLOMPO ISLAND, MAKASSAR CITY

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ABSTRACT

This study aimed to identify the types of soft corals of the family Alcyoniidae based on their morphological characteristics and spicule shape; determine the composition of the type and vertical distribution of soft corals; and analyze the relationship between the distribution of soft corals of the Alcyoniidae family in the *fore reef zone* with environmental factors in the waters of Barranglompo Island. This research was conducted in the coral reef area on the edge of Barranglompo Island which is divided into four observation stations. Data on species and the number of soft coral colonies were collected using the 100-meter belt transect method, which was placed parallel to the shoreline at two depths. This study identified 23 soft coral species belonging to three genera: *Sinularia, Lobophytum,* and *Sarcophyton*. Five spicule models were found: *clubs, capstan, shuttel, spindle, and barrel,* and the dominant one was the shape *of clubs*. There was no significant difference in the number of types between the research stations in the *upper and lower reef zones*. The density of soft corals differed markedly between stations in the *lower fore reef* zone, with the highest density of 0.19 ind/m2 at the southern station of the island. The high density of soft corals was located in the southwest of the island in the *upper* and *lower fore-reef* zones andwass associated with high light intensity and salinity. The high richness of soft coral types is located in the southeast of the island in the *upper* and *lower fore-reef zones,* which are characterized by turbidity values and high temperatures.

Keywords : soft coral, density, wealth, coral reef zone, spicula

INTRODUCTION

Soft corals are part of the group of invertebrates in coral reef ecosystems. Soft corals belong to the phylum Cnidaria (stinging marine animals), class Alcyonaria, and family Alcyoniidae. According to Haris and Rani (2019), the ecological role of soft corals is as a food source for several types of biota, as a shelter or habitat for several benthic animals, such as snake stars (class Ophiruidea), and as a contributing component of calcium carbonate sediments in various marine ecosystems.

The group of corals that can produce bioactive compounds are soft corals that have the ability to be antibacterial, anticancer, antifouling, and others, where one of the genera that produces bioactive compounds is from the family Alcyoniidae (Mayer et al., 2010). One of the bioactive ingredients found in soft corals of the Alcyoniidae family is terpenoid compounds (Achmad & Akbar, 2017). According to Rachmaniar (1994), these terpenoid compounds are essential for self-defense against predator attacks in terms of fighting for space.

Geographically, soft corals can be found in equatorial and polar waters, living from tidal (intertidal) to the deepest (abyssal) waters. The highest occurrence of soft corals is in shallow, warm waters in the tropics (Haris & Rani, 2019). In Indonesia, soft corals of the family Alcyoniidae are generally found at depths of 3–20 m, with a depth concentration of 7-10 m (Manuputty, 2002). According to Rogers et al. (1994), the fore reef zone is a coral reef zone from the top of the reef (crest) to a deeper area (base) at a depth of 3-10 meters.

Soft corals grow and develop optimally in waters with an average annual temperature of 25-32°C, and can tolerate temperatures of up to 36-40°C. Temperature changes in corals can cause a decrease in feeding response, reduce average reproduction, secrete a lot of mucus, and reduce photosynthesis and respiration (Haris, 2001).

Naturally, the ecological role of soft corals is as a food source for several types of biota, as a shelter or habitat for several benthic animals, such as snake stars (class Ophiruidea), and as a contributing component of calcium carbonate sediments in various marine ecosystems (Haris & Rani 2019). According to Riana (2023), the cover of live corals in the waters of Spermonde, South Sulawesi, experienced degradation of 18.93% in 2021 and 2022, respectively. This can cause fishermen's catches to deteriorate owing to the uncontrolled exploitation by the surrounding community. Based on these data, efforts should be made to prevent the decline of soft coral populations by conducting an inventory of their presence and abundance to determine the level of damage inflicted.

Therefore, it is necessary to conduct research to determine the distribution of soft corals, especially in the Alcyoniidae family, in the fore reef zone of the Spermonde Islands, particularly on Barranglompo Island, Makassar City.

MATERIALS AND METHODS

This research was conducted from November 2021 to March 2022, which took place on Barranglompo Island, Sangkarrang District, Makassar City, including the preparation stage, field data collection and type identification. The plan is to set up four stations around the islands.

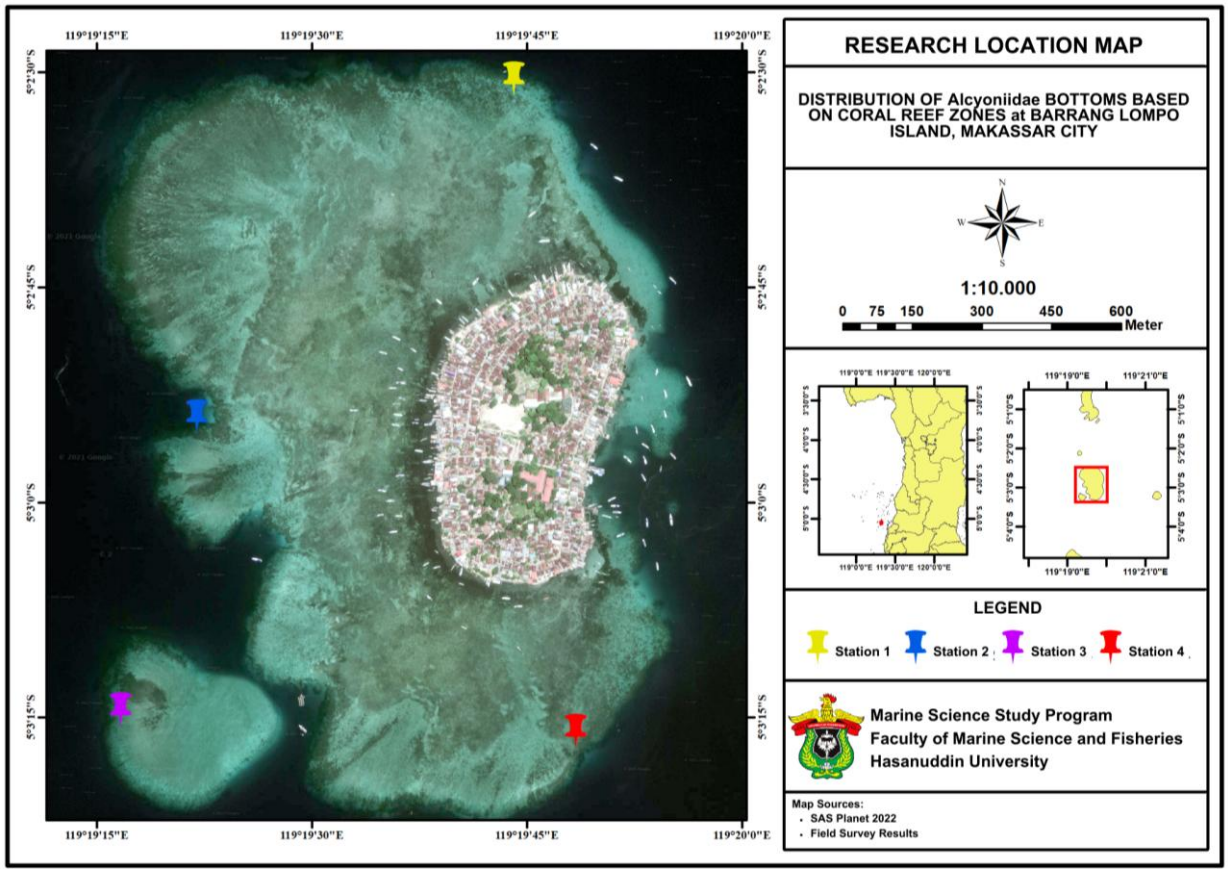


Figure 1.The location of the fourth research station in the coral reef waters of Barranglompo Island, Makassar City.

Research Procedure

Soft corals were observed using the Belt Transect method, which was used to determine the existence of soft corals, including the number of colonies, largest diameter, and number of types in a coral reef area. (Suharsono, 1994 in Bahar, 2015).

Soft coral data collection using diving equipment. Roll meters were installed along 100 m parallel to the coastline at depths of 3-5 meters (upper fore reef zone) and 7-10 meters (lower fore reef zone). The length of the transect was 100 m and divided into four subtransects as a repeat with a length of 20 m each, and the subtransects were separated by a distance of 5 m. Observations on each subtransect are 4 meters wide, namely 2 meters on the left side and 2 meters on the right side.The identification of soft coral growth forms was carried out by observing the morphological forms and then matching them with the literature used, based on the growth form according to Fabricius and Alderslade (2001), Schleyer and Benayahu (2017), and Haris and Rani (2019). Those that were not identified were sampled and placed in sample bottles filled with 70% alcohol for further identification in the laboratory. To confirm the type found, the spicle model was also observed. Preparations from each soft coral sample were taken from the basal part, capitulum, and around the oral disc and fixed with 70% ethanol. Bleach (Bayclin brand) was used to remove the living tissue. The process of determining species based on the spicule model of each type followed the instructions of Haris & Rani (2019), Manuputty (2002), Verseveldt (1980), Verseveldt (1982), and Verseveldt (1983).

After identifying the growth of soft corals and spicules, environmental parameters covering physical and chemical parameters were many as three times. The

environmental parameter data collected were as follows: (1) Temperature: Temperature measurements were carried out directly in the field using a thermometer by placing a thermometer on the surface of one of the soft coral colonies and then waiting until the value indicator on the thermometer was no longer moving. The value was read and the scale results were recorded. (2) Salinity Measurements were performed directly in the field using a hand refractometer. First, the tool was sterilized using aquades water. Subsequently, the seawater sample was dripped onto the device using a dropper, and the device was closed. Next, the handrefractometer was pointed at the light to determine the salinity value read on the device. To be more accurate, measurements were made three times, (3) The intensity of light was measured at each observation station three times using a lux meter. The lux meter is dipped into the water column and then records the results of the light intensity measurement on the lux meter reading screen, (4) Turbidity The measurement of the turbidity level of water is carried out at each observation station three times using the turbidity meter. The level of turbidity or turbidity of water is indicated by the Nephelometric Turbidity Unit (NTU) measurement unit.

Data Analysis

The composition of soft corals was calculated using the following formula (Bengen, 2002 in Bahar, 2015):

Composition Type: Number of individuals of type i/Number of individuals from all species X 100

The density of soft corals was calculated using the following formula (Kusmana, 1997, in Bahar, 2015):

$$D=Ni/A$$

Description:

D = density (ind/m2)

Ni = number of types (ind)

A = subtransect area (m2)

The number of types was determined by calculating the number of types in each transect repeat at each station. The composition of soft coral types at each station was compared descriptively using tables and graphs. The density and number of soft coral types in each repeat were grouped by station for each depth (zone) and by zone for each station. The difference in the number of types and densities between stations was determined using one-way ANOVA, and if there was a difference, Tukey's test was performed. Meanwhile, the difference between zones by station was determined using the t-student test. The calculation and analysis processes will be carried out using SPSS 20.0 software.

To determine the relationship between the distribution of soft corals and environmental factors, each repeat at each station was used in a multivariate statistical test with the Principal Component Analysis (PCA) technique, which was calculated using the XL-Stat software.

RESULTS AND DISCUSSION

Types of Soft Corals

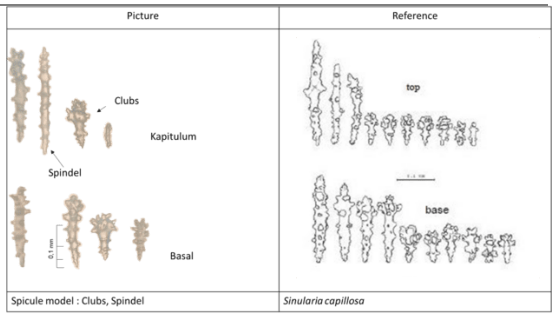
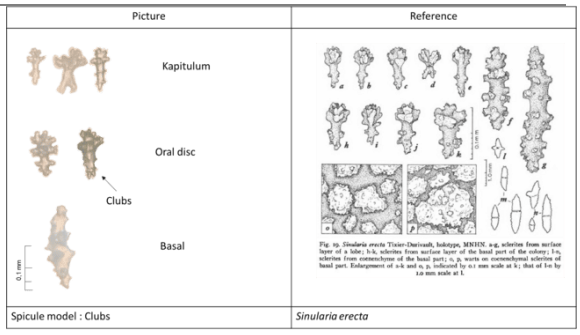
The identification of soft corals of the Alcyoniidae family found in the fore-reef zone of the waters of Barranglompo Island revealed 23 species. The species belong to three genera: Sinularia, Lobophytum, and Sarcophyton. Fifteen species were found in the genus Sinularia 15 species were found in the genera Lobophytum and Sarcophyton 4 species are found each. The distribution of soft coral types by zone in the coral reef waters of Barrang Lompo Island is shown in Table 1.

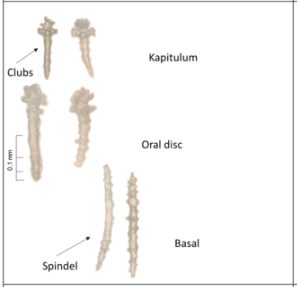
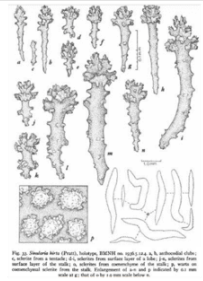
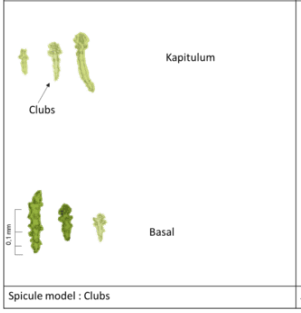
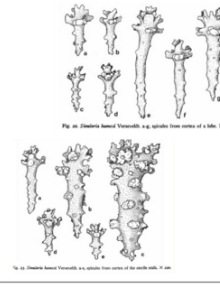
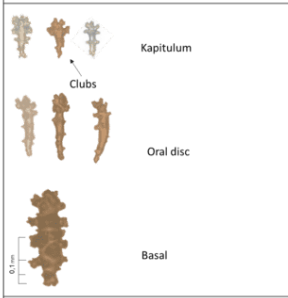
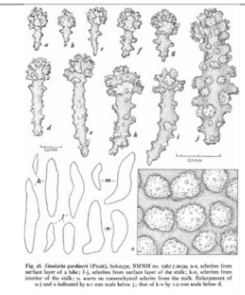
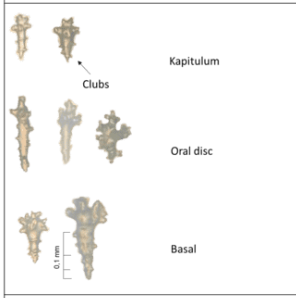
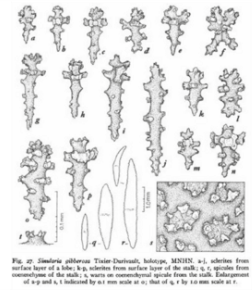
Table 1. Types of soft corals found in the fore reef zone

No.	Genus	Species	Growth form	*Upper fore reef*	*Lower fore reef*
1	Sinularia	*Sinularia capillosa*	Encrusting	✓	✓
2		*Sinularia erecta*	Encrusting	✓	✓
3		*Sinularia hirta*	Lobata	✓	✓
4		*Sinularia humesi*	Lobata	–	✓
5		*Sinularia gardineri*	Lobata	✓	✓
6		*Sinularia gibberosa*	Encrusting	✓	✓
7		*Sinularia molesta*	Lobata	✓	✓
8		*Sinularia polydactyla*	Glomerata	✓	✓

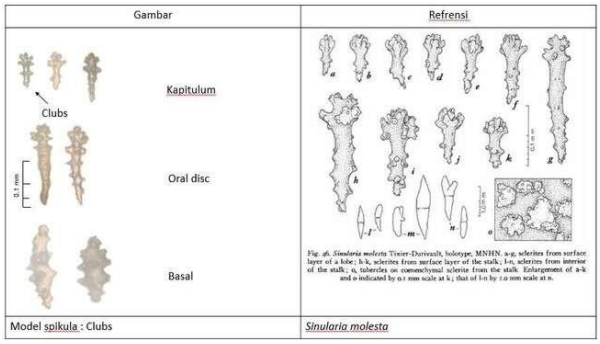
9		*Sinularia grandilobata*	Glomerata	✓	✓
10		*Sinularia minima*	Glomerata	✓	✓
11		*Sinularia lochmodes*	Lobata	✓	–
12		*Sinularia cruciate*	Lobata	✓	✓
13		*Sinularia nanolobata*	Glomerata	✓	✓
14		*Sinularia triangula*	Encrusting	✓	–
15		*Sinularia maxima*	Encrusting	✓	–
16	Lobophytum	*Lobophytum venestum*	Encrusting	✓	–
17		*Lobophytum pauciflorum*	Encrusting	✓	✓
18		*Lobophytum crassum*	Encrusting	✓	–
19		*Lobophytum latilobatum*	Encrusting	✓	✓
20	Sarcophyton	*Sarcophyton digitatum*	Umbellata	✓	–
21		*Sarcophyton infundibuliforme*	Lobata	–	✓
22		*Sarcophyton roseum*	Umbellata	–	✓
23		*Sarcophyton subviride*	Encrusting	–	✓
Total				19	17

Table 1. Morphology and Spikula of soft corals of the Alcyoniidae family in the fore reef zone of Barranglompo Island

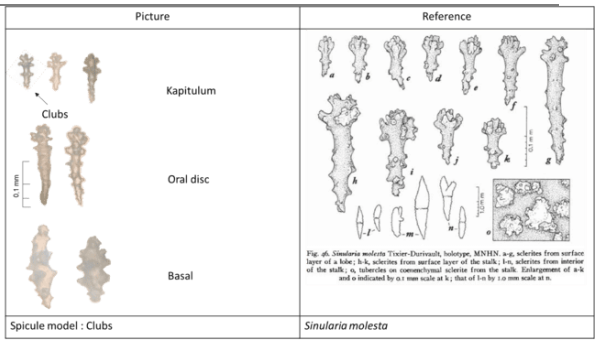
Species	Morphology	Spiculus
Sinularia Capillosa		
Sinularia erecta		

		Picture	Reference
Sinularia hirta			
		Spicule model : Clubs, Spindel	*Sinularia hirta*
Sinularia humesi			
		Spicule model : Clubs	*Sinularia humesi*
Sinularia gardineri			
		Spicule model : Clubs	*Sinularia gardineri*
Sinularia giberrosa			
		Spicule model : Clubs	*Sinularia gibberosa*

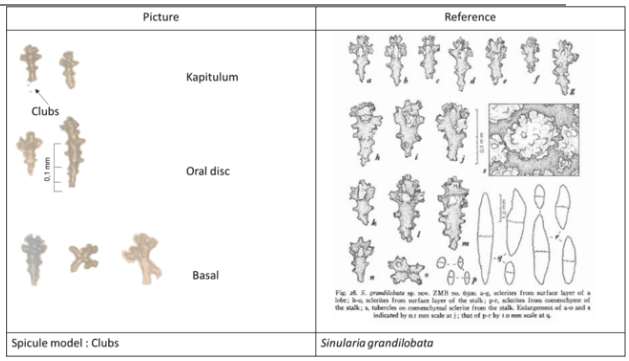
Sinularia molesta



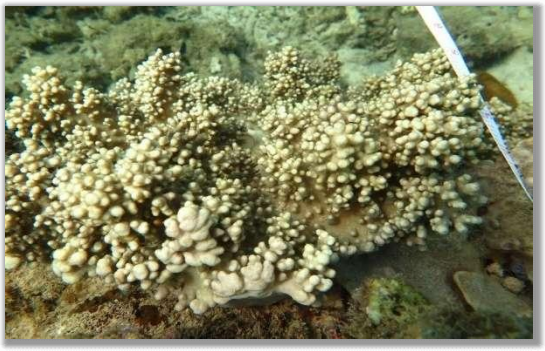
Sinularia polydactyla

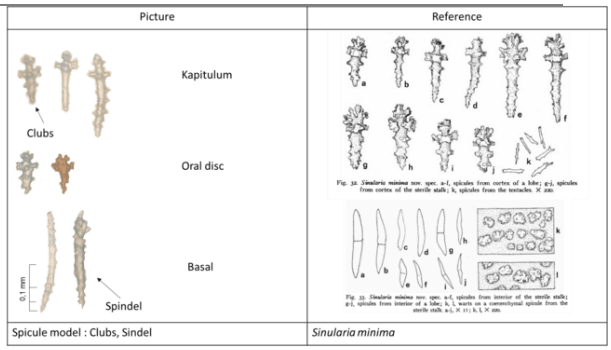


Sinularia grandilobata



Sinularia minima





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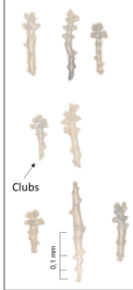
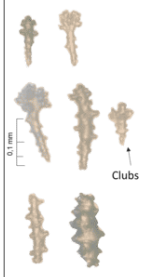
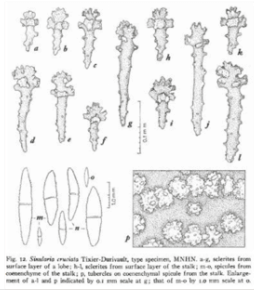
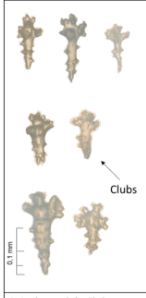
Sinularia lochmodes

Picture	Reference
	
Spicule model : Clubs	*Sinularia lochmodes*

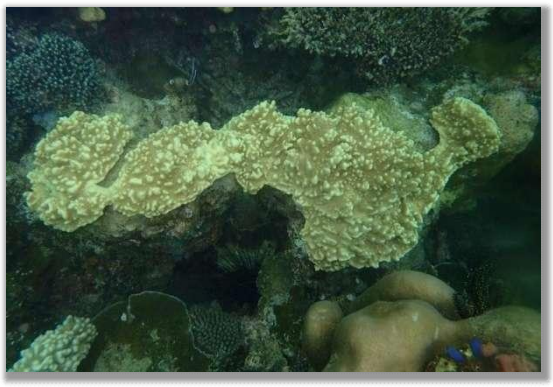
Sinularia cruciate

Picture	Reference
	
Spicule model : Clubs	*Sinularia curicata*

Sinularia nanolobata

Picture	Reference
	
Spicule model : Clubs	*Sinularia nanolobata*

Sinularia triangula



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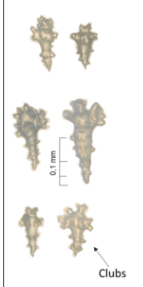
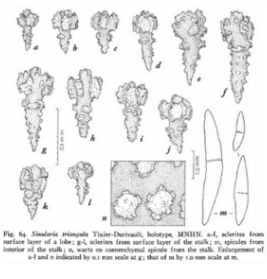
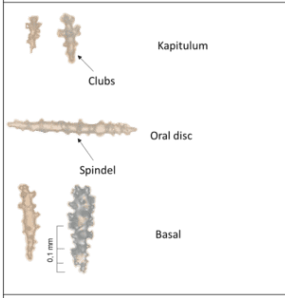
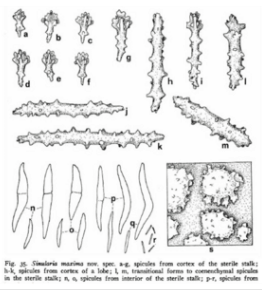
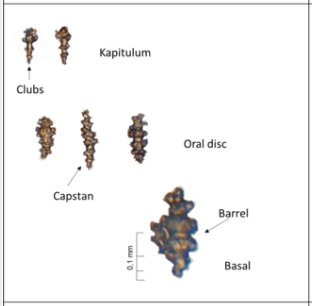
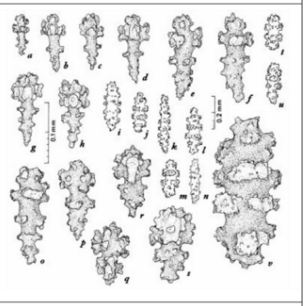
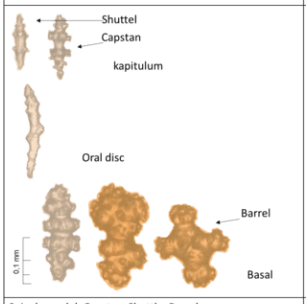
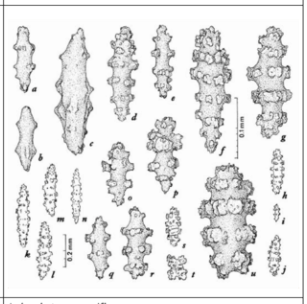
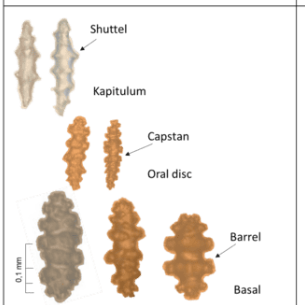
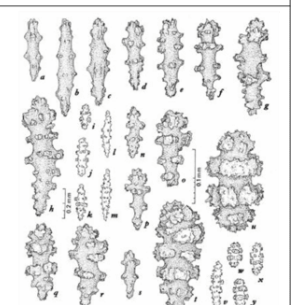
	
Spicule model : Clubs	*Sinularia triangula*

		Picture	Reference
Sinularia maxima		 Spicule model : Clubs, Spindel	 *Sinularia maxima*
Lobophytum venustum		 Spicule model: Club, Capstan, Barrel	 *Lobophytum venustum*
Lobophytum pauciflorum		 Spicule model: Capstan, Shuttle, Barrel	 *Lobophytum pauciflorum*
Lobophytum crissum		 Spicule model: Capstan, Shuttle, Barrel	 *Lobophytum crassum*

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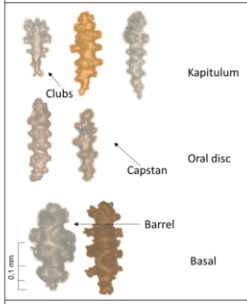
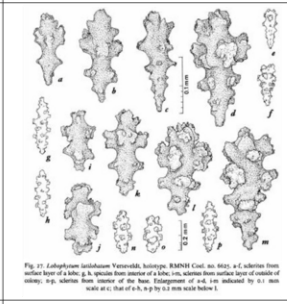
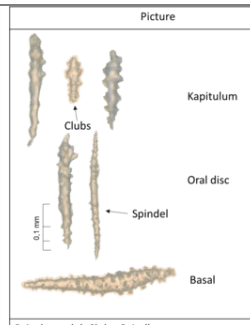
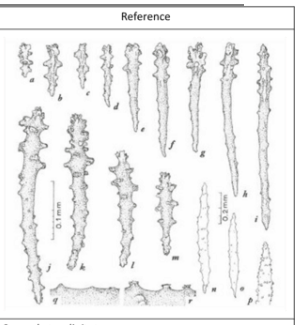
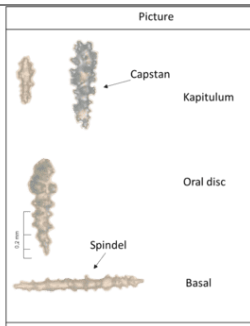
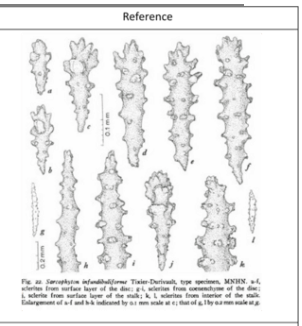
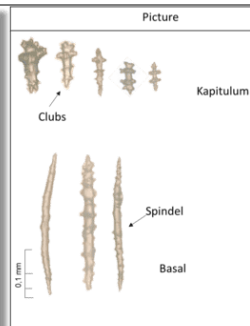
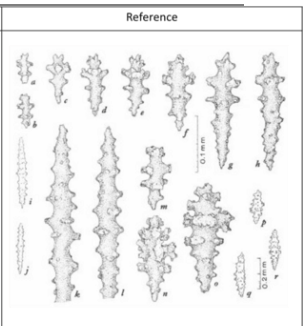
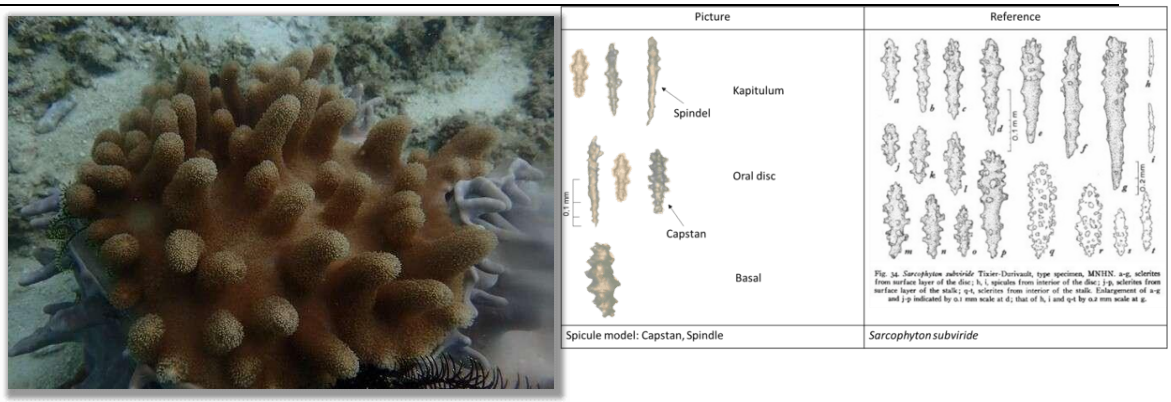
		Picture	Reference
Lobophytum latilobatum		 Spicule model: Club, Capstan, Barrel	 *Lobophytum latilobatum*
Sarcohyton digitatum		 Spicule model: Clubs, Spindle	 *Sarcophyton digitatum*
Sarcophyton infundibuliforme		 Spicule model: Capstan, Spindle	 *Sarcophyton infundibuliforme*
Sarcophyton roseum		 Spicule model: Clubs, Spindle	 *Sarcophyton roseum*

Sarcophyton subviridae



Composition

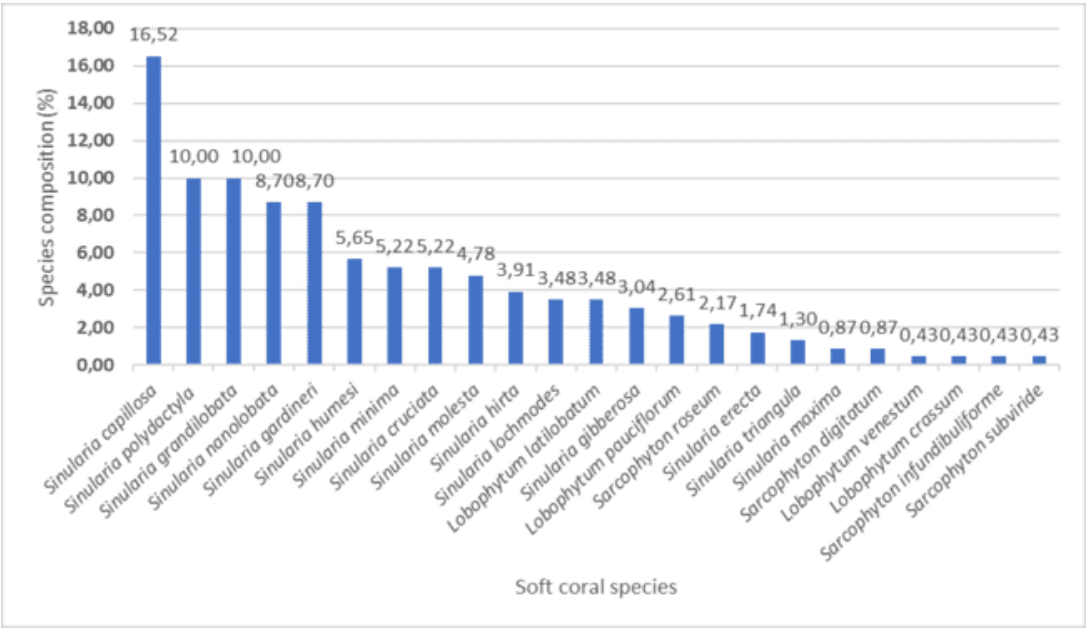


Figure 2. Composition of soft coral species of the family Alcyoniidae

Based on the results of observations in the fore reef zone of Barranglompo Island at four observation stations (Figure 2), 23 species of soft corals were found that have been identified and belong to the Alcyoniidae family, which are divided into three genera: Sinularia (15 species), Lobophytum (four species), and Sarcophyton (four species). In Indonesia, according to Manuputty (2016) in Haris and Rani (2019), the distribution of soft corals of the genus Sinularia in the waters of the Derawan Islands, East Kalimantan, found 30 species of Sinularia at 22 observation stations. Furthermore, Manuputty (2016) reported that 18 genera of soft corals belonging to the family Alcyoniidae were successfully collected from the waters off East Biak, Papua. Three genera were found: Sinularia, Sarcophyton, and Lobophytum, with Sinularia having the highest number of species.

Five models were found in the observation of the spicle model: clubs, capstans, shuttles, spindles, and barrels.

In soft corals of the genus Sinularia, two models of spicules have been found, with the dominant one being the club model. The genus Lobophytum has four spicule models: clubs, capstan, shuttle, and barrel, with the barrel shape being the dominant one. The variety of spicule models in this genus is suspected to be related to the form of creeping growth and dense colony form compared to other genera of soft corals. In the genus Sarcophyton, there are three spicule models, the dominant one being spindle-shaped.

Number of Types

In general, the highest distribution of soft corals was in the upper fore-reef zone, followed by the lower fore-

reef zone. This indicates that depth affects the distribution of soft corals in the fore reef zone.

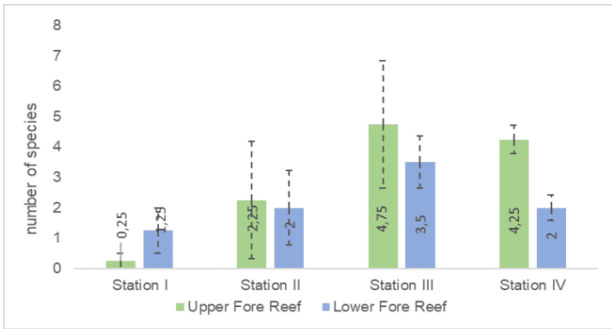


Figure 3. A comparison graph of the number of soft coral species of the family Alcyoniidae found in the upper and lower fore reef zones at each research station (the asterisk indicates a marked difference based on the t-student test at alpha 5%; ns indicates no significant difference).

Of all the research stations, the highest distribution of soft corals was found at Station III. The large number of types obtained at this station is suspected to be due to the abundance of soft corals with encrusting growth forms and digitiform finger lobes (digitiformes). In addition, the location of the station far from the mainland is one of the causes of the high number of soft corals there.

In each coral reef zone (upper and lower fore reef), the highest number of species was found in the upper fore reef zone. The large number of species obtained is due to the abundance of soft corals in this zone compared to the lower fore-reef zone. There are a small number of soft coral types.

The low number of species in the Lower Fore Reef zone may be due to the fact that only a few types of soft corals can tolerate the environmental conditions that occur in this zone, including low light intensity.

Another factor that causes the lack of species found in the lower fore reef zone is the presence of predators of this organism, such as fish from the family Chaetodontidae and mollusks such as the gastropod Ovula ovum. According to Haris and Rani (2019), one of the ecological roles of soft corals is as a food source for several types of marine organisms.

Density

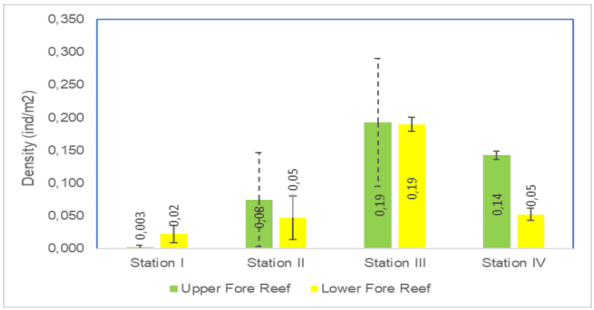


Figure 4. Density values of soft corals of the Alcyoniidae family between zones in the fore reef at each research station (asterisk indicates a significant difference based on the Student's t-test at alpha 5%; the ns symbol indicates no significant difference).

The results of the observation of soft coral density at all stations on Barranglompo Island showed a difference in soft coral density. Station III had a high density value, whereas Station I had a low density value. The low density at Station I is suspected to be due to the condition of the coral reef, which is still quite good, so that some types of soft corals are unable to compete for space.

Coral reef zones (upper and lower fore reef) differed in soft coral density. At Station I, the density in the upper fore reef zone was lower than that in the lower fore-reef zone. At Stations II and IV, the density in the upper fore reef zone was higher than that in the lower fore reef zone, whereas at Station III, the density in the upper and lower fore reef zones was the same. The higher density in the upper fore reef zone is suspected to be due to the higher intensity of light obtained by soft corals, so the growth phase is higher than that in the lower fore reef zone. According to Tong et al. (2011) in Hamzah (2020), the process of soft coral photosynthesis is influenced by the intensity of light entering the water, and soft corals are required in the growth phase.

The Relationship Between Soft Coral Distribution And Environmental Factors

Table 2. Environmental factors at the research site

Enviromental parameters	Observation station								Optimal Condition (Haris & Rani, 2019)
	Station 1		Station 2		Station 3		Station 4		
	UFR	LFR	UFR	LFR	UFR	LFR	UFR	LFR	
Salinity (ppt)	30,00	29,67	32,33	30,67	32,67	32,00	29,33	29,67	32 – 35
Temperature (°C)	29,0	28,5	30,0	29,0	30,0	29,0	31,0	31,0	26 – 28
Light intensity (lux)	2221,0	1726,0	2236,5	1732,0	3706,5	2953,0	1687,0	943,0	-
Turbidity (NTU)	0,00	0,00	0,69	0,64	0,54	0,45	1,13	0,65	<5

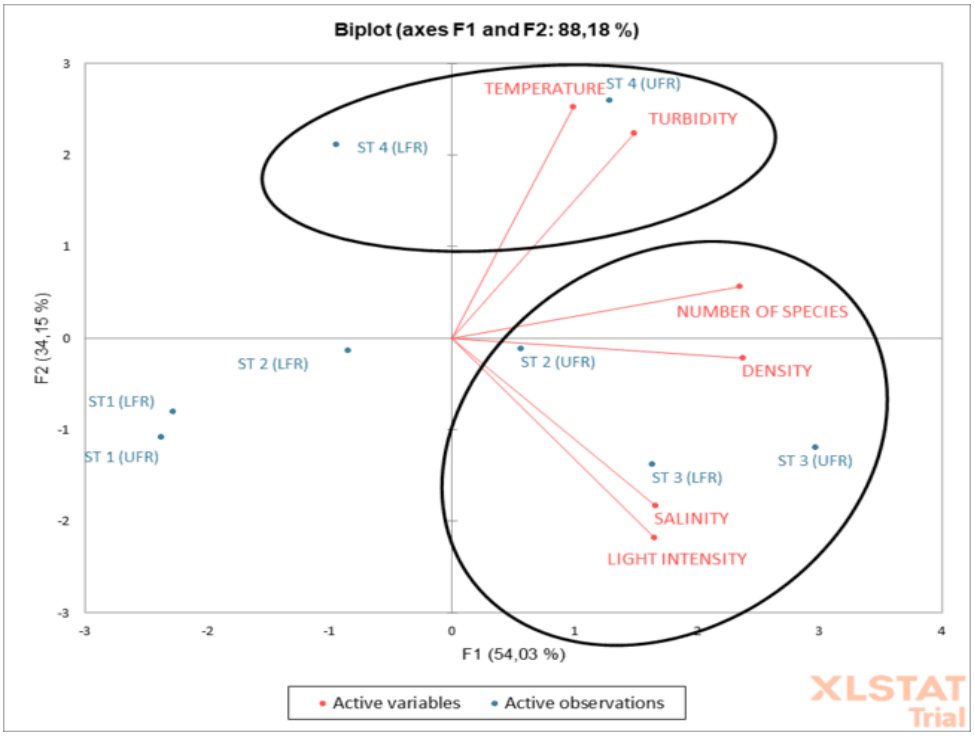


Figure 5. PCA analysis of the number of soft coral types and density with environmental factors.

Based on the results of the Principal Component Analysis (PCA), it was found that at Station III, the upper and lower fore reef zones were characterized by high density and were related to high light intensity and salinity. The high density of soft corals at Station III in the upper and lower fore reef zones may be due to the worse conditions of the coral reefs than those at other stations. According to Sorokin (1993) in Mu'min (2004), soft corals are an important component of coral reef recovery, especially in coral reef areas damaged by environmental or anthropogenic factors. The intensity of light or clear water columns also greatly affects the growth of soft corals of the Alcyoniidae family because this type of soft coral requires light for photosynthesis (Tong et al., 2011 in Hamzah, 2020). Meanwhile, the low density and number of soft coral types at Station I is suspected to be because Station I has good coral reef

conditions, so soft corals lose in the space competition that occurs with coral reefs and other benthic animals. At Station IV, the upper and lower fore reefs are characterized by high levels of turbidity and temperature and are associated with a high number of species, suspected to be a diverse number of species at Station IV due to high diversity and are still in the recovery phase of coral reef ecosystems. Based on the preference of soft corals for environmental factors, it was found that corals generally grow and develop optimally in waters with an average annual temperature of 25-32°C, and can tolerate temperatures of up to 36-40°C. Temperature changes in corals can cause a decrease in feeding response, reduce average reproduction, secrete a lot of mucus, and reduce photosynthesis and respiration (Haris, 2001).

CONCLUSION

Based on the results of this study, the composition of soft corals of the Alcyoniidae family in the fore reef zone of Barranglompo Island consists of 23 species from three genera, with the dominance of the genus Sinularia and five most common forms of spicules in the form of clubs. In general, there was no real difference in the number of types between stations or between the upper and lower fore reef zones, except at the southern station of the island in the lower fore reef zone, which showed the highest density (0.19 ind/m ^{2}). The highest density distribution was found in the southwest of the island, which correlates with light intensity and high salinity, whereas the greatest species richness was in the southeast of the island, which is characterized by turbidity and higher water temperatures. These findings suggest that local environmental variations, particularly light, salinity, turbidity, and temperature, play an important role in influencing the distribution of soft coral species density and richness on the island.

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