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NUDIBRANCHIA DENSITY AND DIVERSITY IN SPERMONDE ISLANDS, SOUTH SULAWESI

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ABSTRACT

Nudibranchia is one of the interesting and unique organisms because it has different shapes, sizes and colors attracting tourists when doing snorkeling and diving activities. However, because the distribution of marine biota is very dependent on habitat conditions and the availability of food types, it affects the density and diversity of Nudibranchia in the waters. The purpose of this study was to determine the density and diversity of Nudibranchia species. This research was conducted in March-April 2021 on Samalona Island, Barranglompo Island, and Badi Island in the Spermonde Islands, South Sulawesi. The method used is the Belt Tansect method with a length of 100 m with a sweep of 2.5 m to the left and right, at a depth of 4-7 m. Based on the results of the study, the number of Nudibranchia species found on Samalona Island was 4 families, 7 species, and 36 individuals; on Barranglompo Island as many as 4 families, 6 species, and 51 individuals; while on Badi Island there are 3 families, 6 species, and 30 individuals. Nudibranchia density on Samalona Island is 0.024 ind/m2, on Barranglompo Island is 0.034 ind/m2, while on Badi Island it is 0.020 ind/m2. The value of the Nudibranchia Diversity Index on Samalona Island is 1.14; on Barranglompo Island by 0.96; and on Badi Island it was 1.28 with a diversity community structure that was quite stable to stable on each island. Substrate cover conditions found on each island were dominated by Dead Coral Algae (DCA), on Samalona Island at 58.33%; Barranglompo Island by 54.90%; and Badi Island by 66.67%.

Keywords: Nudibranchia, density, diversity, Samalona Barranglompo, Badi.

INTRODUCTION

Nudibranchia or sea hares is the largest order of Heterobranchia, class Gastropods, which consists of 3000 species that have been identified in the world and which are identified in Indonesian waters as many as 59 species and consists of 15 families. Nudibranchia can be classified as follows: Kingdom: Animalia; Phylum: Mollusca; Class: Gastropods; Subclasses: Opisthobranchia; Order: Nudibranchs; Suborders: Doridina; Family: Chromodorididae, Phylididae, Polyceridae, Discodorididae (Picton & Morrow, 1994).

Nudibranchia consists of the words 'Nudus' meaning naked and 'Branchia' meaning gills. This term refers to the external respiratory organs found in Nudibranchia, including mollusks that do not have a shell (Behrens, 2005). It is said to be a sea rabbit because it has rhinophores or a pair of organ organs that resemble tentacles which are located on the dorsal side of the head and also have gills or cerata used for breathing which are located on the dorsal back (Pungus et al. 2017).

The diversity of Nudibranchia species can be seen from the varied shapes, different sizes, and striking colors of Nudibranchia, making it one of the interesting underwater photo objects and must be documented for divers because there are generally Nudibranchia colors that are black, yellow, or yellow. blue, green, gray, white, orange, pink, and purple. According to Godfrey (2001) Nudibranchia diversity can be seen in the conditions of different living habitats, such as the condition of coral reef cover, habitat availability and types of food. From these three things, it can be seen that many Nudibranchs eat and live in association with coral reefs.

The availability of sufficient food sources can be obtained from the coral reef ecosystem area. In addition, coral is a place of attachment for veliger larvae from Nudibranchia before metamorphosis into juveniles. Nudibranchia use corals as feeding ground and spawning ground, without harming or disturbing coral life (Ruswahyuni and Subiyanto, 2013). In general, Nudibranchia eats algae, sponges, hard and soft corals, bryzoans, and hydroids (Darmawan, 2014). Several studies have shown that the distribution of Nudibranchia is found in sponges and corals. The research results of Aunorohim et al. (2008) showed that Nudibranchia was eating the sponge *Phylospongia papiraseae*.

Nudibranchia has potential as an antiviral and anticancer, as a model and biological tool for the development of science, a source of natural products in the form of bioactive ingredients that are useful in medicine, as well as ornamental biota that have a high selling value because of their charm in aquariums because of their cute and attractive shapes (Ibrahim , 2014). This can attract scientists to study more about the ingredients contained in the body of Nudibranchia which can be developed as new science in the pharmaceutical and medical fields.

The Spermonde Archipelago is a group of small islands located in the Makassar Strait spread across Barru Regency, Pangkajene Islands Regency, Makassar City and Takalar Regency with a total of 172 islands (Sul-Sel Regional Regulation on RZWP3K No.2, 2019). Samalona Island is located in Mariso Village, Mariso District, Makassar City, South Sulawesi. This island is a tourist area that has white sand and clear waters that are in great demand by tourists who want to do snorkeling and diving activities. Barranglompo Island is located in the District of Sangkarrang Islands, Makassar City, South Sulawesi. This island is an area of anthropogenic activity because some people have jobs as fishermen, mixed traders, transportation service providers. Badi Island is located in Mattiro Deceng Village, Liukang Tupabbiring District, Pangkep Regency. This island is an area that has a Marine Protected Area (DPL), and has a coral reef transplant area carried out by PT. Mars.

Research on the density and diversity of Nudibranchia in the Spermonde Archipelago is still limited, therefore, research is needed to determine the species of Nudibranchia in Samalona Island, Barranglompo Island, and Badi Island and be able to determine the species of Nudibranchia and use it as a database and information related to the species of Nudibranchia found in each observation location and can be used as an underwater tourist attraction for tourists or divers who like underwater photography.

MATERIALS AND METHODS

This research was conducted in March - April 2021 on Samalona, Barranglompo, and Badi Islands in the Spermonde Archipelago, South Sulawesi (Figure 1).

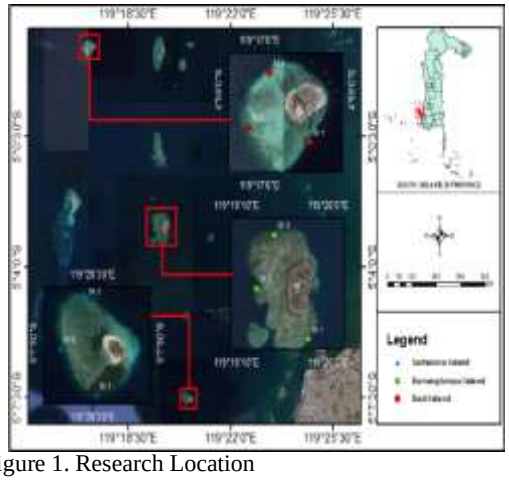

Figure 1. Research Location

Observation Method

Nudibranch Data Collection

Nudibranchia data were collected at each location using the Belt Transect method (Figure 2) along a 100 m length using a rollmeter and diving equipment with a sweep of 2.5 m to the left and right in a zig-zag manner, parallel to the shoreline at a depth of 4-7 meters. The sampling area was 500 m² (English et al., 1994).

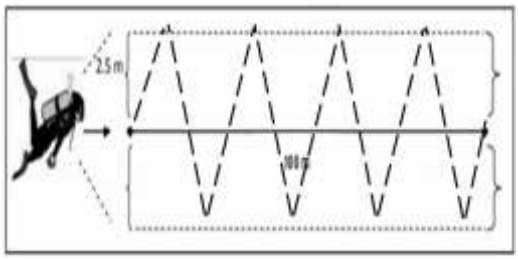

Figure 2. *Belt Transect Method* (English *et al*., 1994).

Sampling was carried out from morning to evening to determine the species of Nudibranchia found at each location. Nudibranchia data collection was carried out by taking pictures of each species of Nudibranchia found at the observation station location and then identified using a Nudibranchia identification book to find out its species such as the book 1001 Nudibranchs Catalog of Indo-Pacific Sea Slugs (Coleman, 2001), the book Nudibranchs Ecyclopedia Catalog of Asia/Indo-Pacific Sea Slugs (Coleman, 2001), Indonesia Nudibranchs & Sea Slugs (Anderson, 2018), Papua New Guinea Nudibranchs & Sea Slugs (Anderson, 2020), and website http://www.nudibranch.org .

Nudibranchia density at each observation station, can be calculated using the following formula: (Campbell, 2004).

$$D = \frac{N}{500\ m2.}$$

Where;
D = Density of Nudibranchia individual/m2
N = Total number of individual per station

Diversity Index of Nudibranchia was calculated using the following formula (*Shannon-Weaver*) (Wibisono, 2005):

$$H' = - \Sigma [(ni/N) \times \ln (ni/N)]$$

Where;
H' = Shannon-Weaver's Diversity Index
ni = Number of individual of the Species-i
N = Number of total individual of all species

Wibisono (2005) interpreted the value of the Diversity Index in tabel 1.

Table 1. Criteria For Coral Reef Cover Conditions.

Species Diversity Index	Community Structure
>2.41	Very Stable
1.81-2.4	More Stable
1.21-1.8	Stable
0.61-1.2	Quite Stable
<0.6	Unstable

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Collection of Bottom Coverage Data

Coral reef bottom substrate cover data was collected using the Point Intercept Transect (PIT) method (Figure 3). by spreading a line transect (roll meter) along 100 meters at a depth of 4-7 m, Next, recording the type of coral at each 0.5 meter point that is directly below the line transect. Coral reef bottom cover was taken based on lifeforms such as DCA, Algae, Sponge, and Abiotic.

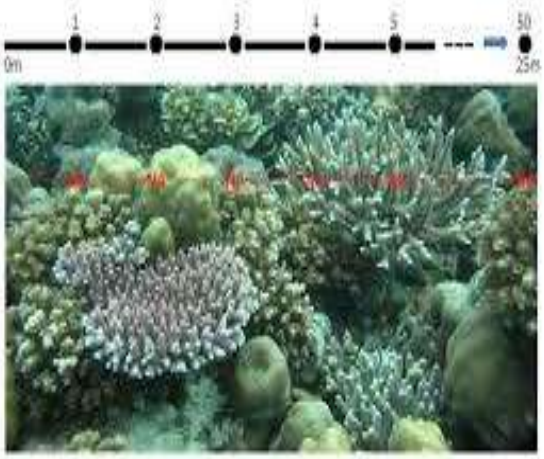

Figure 3. *Point Intercept* Transect (PIT) methode (Manuputty dan Djuwariah, 2009).

Determination of the condition of coral reefs based on the percentage of cover, according to the Decree of the Minister of the Environment No. 4 of 2001 (Table 2).

Table 2. Criteria of Index Diversity Values.

Cover Living Coral (%)	Coral Reef Condition
0 – 24.9	Bad
25 – 49.9	Currently
50 – 74.9	Good
75 - 100	Very good

Measurement of Environmental Parameter

The environmental parameters measured were Temperature, Salinity, Current Speed and Brightness. Parameter measurements were repeated three times on each observation island.

Data Analysis

Data analysis on the density and diversity of Nudibranchia on each island can be seen in the form of pictures, graphs or tables and then described descriptively to determine the density and diversity of Nudibranchia found on each island.

RESULTS AND DISCUSSION

Nudibranchia Species

Several species of Nudibranchs found during the study displaye in Table 3.

Table 3. Species of Nudibranchs Found On Every Island

Class	Subclass	Order	Suborder	Family	Species	Samalona	Barranglompo	Badi
Gastropoda	Heterobranchia	Nudibranchia	-	Aglajidae	*Pleasant chelidonura*	0	4	0
			Doridina	Chromodoridae	*Chromodoris reticulata*	2	0	0
					Chromodoris geometrica	2	0	0
					Chromodoris annae	0	1	0
					Glossodoris atromarginata	2	0	0
					Glossodoris acosti	0	0	1
					Goniobranchus coi	0	0	3
					Hypselodoris tryoni	0	0	1
				Kentrodorididae	*Jorunna funebris*	1	0	0
				Phyllidiidae	*Phyllidia pustulosa*	15	10	13
					Phyllidia varicosa	5	7	7
					Phyllidiopsis xishaensi	0	2	0
			Cladobranchia	Facelinidae	*Pteraeolidia semperi complex*	9	27	5
					Total	36	51	30

Table 3 informs that the highest number of species found on Barranglompo Island was 51 individuals with 6 species, while the least was found on Badi Island were 30 individuals with 6 species. The most common Nudibanchia species found on Samalona Island were *Phyllidia pustulose* as many as 15 individuals; on Barranglompo Island there were 27 individuals of *Pteraeolidia semperi* complex; On

Badi Island there were 13 individuals of *Phyllidia pustulose*. The differences in the characteristics of each location can illustrate that the number and species of Nudibranchs found also vary depending on the availability of habitat and the type of food. This is because Barranglompo Island is an area with a lot of anthropogenic activity and the population is quite dense with a coral reef cover percentage of 47.17% belonging to the medium category, while on Badi Island there are DPL areas and coral reef transplants that are still guarded by the community with a percentage of reef cover. 53.83% of corals are classified as good category (figure 7). Several species of Nudibranchia were found on Samalona Island, Barranglompo Island, and Badi Island in Figure 4.

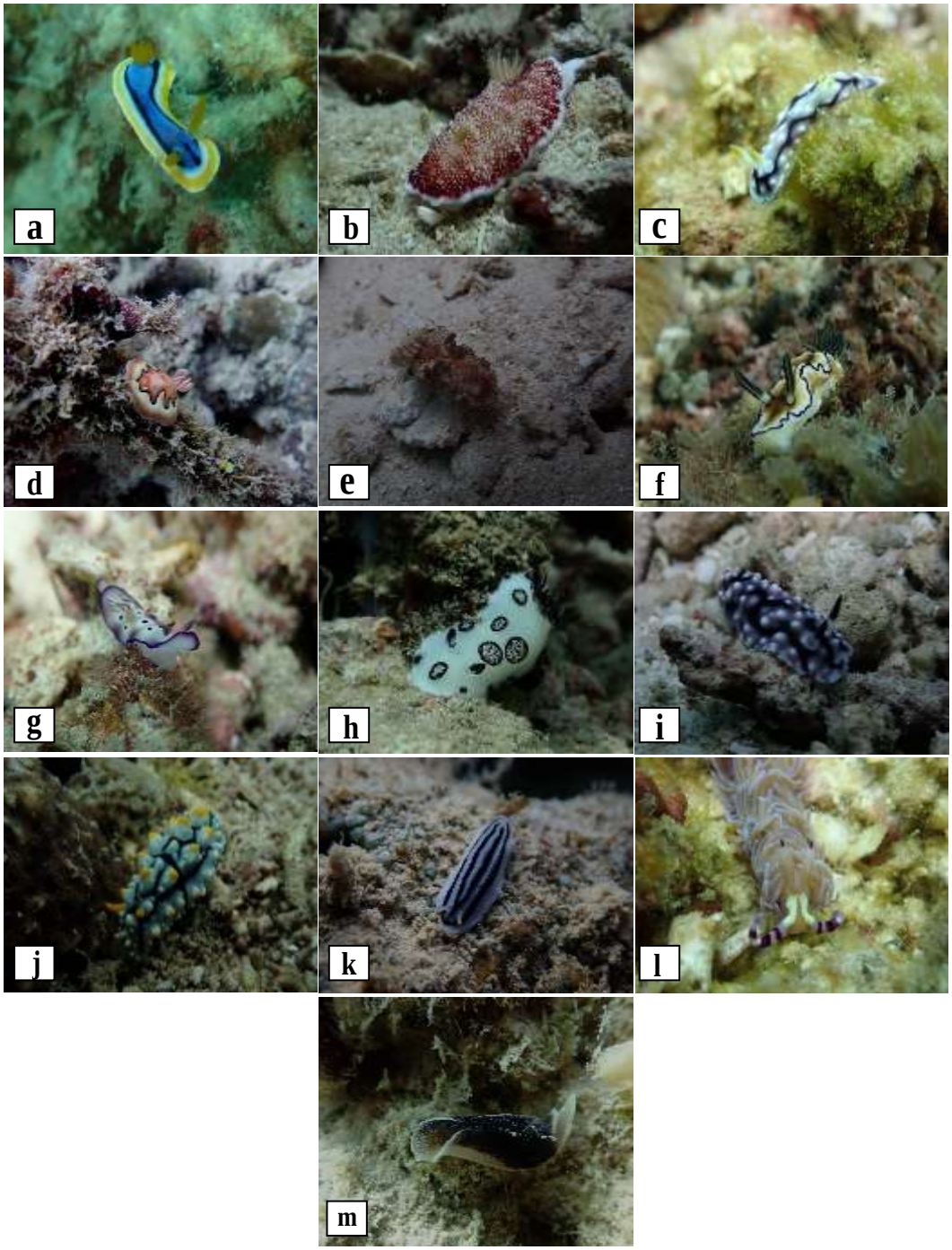

Figure 4. Nudibranchia species found on Samalona Island, Barranglompo Island, and Badi Island a. *Choromodoris annae*, b. *Chromodoris geometrica*, c. *Chromodoris reticulate*, d. *Goniobranchus coi*, e. *Glossodoris acosti*, f. *Glossodoris atromarginata*, g. *Hypselodoris tryoni* h. *Jorunna funebris*, i. *Phyllidia pustulosa*, j. *Phyllidia varicose*, k. *Phyllidiopsis xishaensi*, l. *Pteraeolidia semperi complex*, dan m. *Pleasant chelidonura*.

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Nudibranchia Density

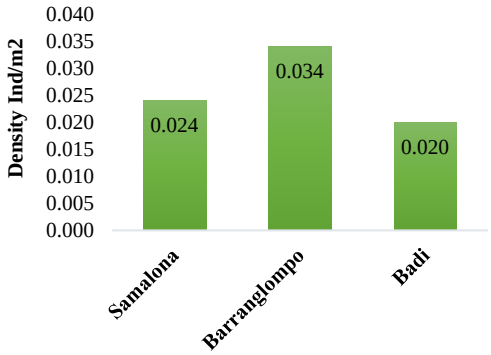

Figure 5. Nudibranch Density Each Island.

The highest density on Barranglompo Island is 0.034 ind/m2, while the lowest density is on Badi Island at 0.020 ind/m2. Nudibranchia density is the number of individuals per unit area so that it can provide an overview of the condition of the population (Campbell, 2004). According to Godfrey (2001) in his research, it was stated that Nudibranchia congregated more in places where coral reefs were healthy compared to damaged ones. The density of Nudibranchia species is strongly influenced by habitat factors and food availability. This is because each species of Nudibranchia has different adaptability. According to Godfrey (2001), the density of Nudibranchia is strongly influenced by the good or bad condition of the percentage of coral reef cover, availability and type of food. A good coral reef will have a coral cover of more than 50% (a combination of hard and soft coral) and low rubble, rock and sand coverage. Some of the main factors that can affect the abundance of species of organisms, species diversity and dominance, namely the destruction of natural habitats such as chemical and organic pollution, land conservation and climate change (Widodo, 1997).

Nudibranchia density and diversity are still very much found in Indonesian waters depending on habitat conditions and food preferences of Nudibranchia. The more food, the more diversity in each location

Table 4. Density of each type of Nudibranchia on each island.

Family	Species	Samalona		Barranglompo		Badi	
		Amount	Specific Density (Ind/m2)	Amount	Specific Density (Ind/m2)	Amount	Specific Density (Ind/m2)
Aglajidae	*Pleasant chelidonura*	0	0	4	0,008	0	0
Chromodorididae	*Chromodoris reticulata*	2	0.004	0	0	0	0
	Chromodoris geometrica	2	0.004	0	0	0	0
	Chromodoris annae	0	0	1	0,002	0	0
	Glossodoris atromarginata	2	0.004	0	0	0	0
	Glossodoris acosti	0	0	0	0	1	0,002
	Goniobranchus coi	0	0	0	0	3	0,006
	Hypselodoris tryoni	0	0	0	0	1	0,002
Facelinidae	*Pteraeolidia semperi complex*	9	0.018	27	0,054	5	0,0083
Kentrodorididae	*Jorunna funebris*	1	0.002	0	0	0	0
Phyllididae	*Phyllidia pustulosa*	15	0.03	10	0,02	13	0,026
	Phyllidia varicosa	5	0.01	7	0,014	7	0,014
	Phyllidiopsis xishaensi	0	0	2	0,004	0	0
	Total	36		51		30	

The density of each species of Nudibranchia (table 4) was mostly found on Samalona Island, i.e., *Phyllidia pustulosa* species at 0.03 ind/m2, on Barranglompo Island, *Pteraeolidia semperi* complex species at 0.054 ind/m2, on Badi Island *Phyllidia pustulosa* species at 0.026 ind/m2 . Family Phyllididae are found on every island in large numbers. Family Phyllididae is one of the

most common species found in the tropics and in the Indo-Pacific region which is very abundant during the day for foraging (Brunckhorst, 1993).

Family Facelinidae are found on every island. The most commonly found on the island of Barranglompo. Family Facelinidae are known to be able to eat hydroids and are also able to symbiotically with zooxanthella obtained from their prey (Mullins, 2021).

Another family with the most species found is Chromodorididae because it is a diurnal organism (Thompson, 1976). Gosliner and Draheim (1996) stated that *Glossodoris* is a genus with a very cosmopolitan distribution and the best diversity in the tropics. Other families found were Kentrodorididae, and Aglajidae. This family is not widely found because only one species of Nudibranchia is found in each family.

Diversity Index of Nudibranchia

Nudibranchia diversity index values found on each island (Figure 6) have different amounts at each observation station.

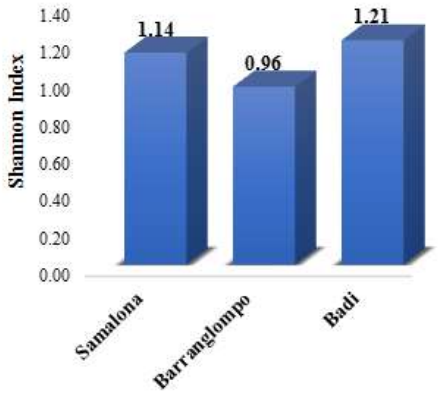

Figure 6. Nudibranch Diversity Index.

Based on the value of the Shannon-Weaver Diversity Index on Samalona Island, a value of 1.14 was obtained and on Barranglompo Island a value of 0.96 was obtained which was classified as a fairly stable community structure, while on Badi Island a value of 1.21 was obtained which was classified as a stable community structure. The Nudibanchia diversity index found on each island is classified as a fairly stable to stable community structure so that it can be said that the water conditions are still good and the availability of food is still abundant on each island (table 8).

The higher the Shannon-Weaver Index value obtained; the more stable water conditions will be.

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According to Brower (1998), the stability of a community is related to the number and level of complexity of energy and nutrient pathways (food webs). The better the level of complexity of the food web, the more stable the community. Stable communities have high species diversity. The research results of Aunurohim et al. (2008) that the Nudibranchia Diversity Index ranges from 1.04 to 1.75 in the White Sands of Situbondo with a fairly stable to stable community structure. The value of the H´ Nudibranchia index in the White Sands of Situbondo ranges from 1,195 to 1,748 with community structures ranging from fairly stable to stable (Sari and Aunorohim, 2013).

Percentage of Substratum Coverage

Based on the results of the measurement of the percentage of coral reef cover on each island, the results of the percentage of coral reef cover are obtained as shown in Figure 7

Based on the Decree of the Minister of the Environment No. 4 of 2001 concerning Percentage of live coral reef cover obtained on Samalona Island of 50.0% classified as "Good" condition, on Barranglompo Island 47.17% classified as "Medium" condition, while on Badi Island 53.83% classified as condition "Good".

The condition of live coral cover on each island is different on Samalona Island, including the island that is used as a tourist spot, Barranglompo Island includes many anthropogenic activities and the population is classified as dense, while Badi Island is an island that has a marine protected area (DPL) and there is also a reef transplant. coral. The difference in live coral cover conditions of the three islands also affected the number and density of Nudibranchia species found

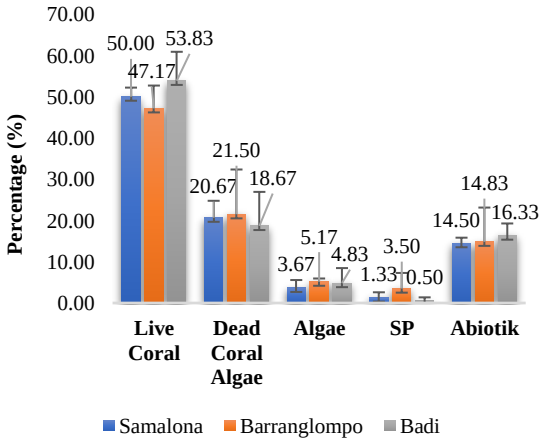

Figure 7. Condition of Living Coral Cover of Each Island

Table 5. Substrates found on Samalona Island.

Family	Species	Substrate			
		DCA	Algae	Sponge	Abiotik
Phyllididae	*Phyllidia pustulosa*	8	5	2	-
	Phyllidia varicosa	3	2	-	-
Facelinidae	*Pteraeolidia semperi complex*	5	2	2	-
Chromodorididae	*Chromodoris reticulata*	2	-	-	-
	Chromodoris geometrica	1	1	-	-
	Glossodoris atromarginata	1	1	-	-
Kentrodorididae	*Jorunna funebris*	1	-	-	-
Total		21	11	4	-
Percentage		58.33	30.56	11.11	-

Table 6. Substrats found on Barranglompo Island.

Family	Species	Substrate			
		DCA	Algae	Sponge	Abiotik
Phyllididae	*Phyllidia pustulosa*	5	3	2	-
	Phyllidia varicosa	5	2	-	-
	Phyllidiopsis xishaensi	-	2	-	-
Aglajidae	*Pleasant chelidonura*	2	2	-	-
Facelinidae	*Pteraeolidia semperi complex*	15	9	3	-
Chromodorididae	*Choromodoris annae*	1	-	-	-
Total		28	18	5	-
Persentase		54.90	35.29	9.80	-

Table 7. Substrats found on Badi Island.

Family	Species	Substrat			
		DCA	Algae	Sponge	Abiotik
Phyllididae	*Phyllidia pustulosa*	9	4	-	-
	Phyllidia varicose	5	2	-	-
Facelinidae	*Pteraeolidia semperi complex*	2	2	1	-
Chromodorididae	*Goniobranchus coi*	2	-	-	1
	Glossodoris acosti	1	-	-	-
	Hypselodoris tryoni	1	-	-	-
Total		20	8	1	1
Percentage		66.67	26.67	3.33	3.33

The type of substrate obtained in this study can be divided into four types of substrate, namely Dead Coral Algae (DCA), Algae, Sponge, and Abiotic. The type of substrate that dominates on Samalona Island is Dead Coral Algae (DCA) with a percentage of 58.33%, and Algae with a percentage of 30.56%, while the percentage of spongy substrate was 11.11% and was inhabited by two species of Nudibranchs only and on Abiotic substrates, there were no Nudibranchs found

(Table 5). Then the type of substrate that dominates on Barranglompo Island is Dead Coral Algae (DCA) with a percentage of 54.90% and Algae with a percentage of 35.29%, Sponge with a percentage of 9.80% where there are only 2 types of Nudibranchia, and on Abiotic substrates there are no Nudibranchs were found (Table 6). Meanwhile on Badi Island the dominant substrate is Dead Coral Algae (DCA) with a percentage of 66.67% and Algae at 26.67%, Sponge and abiotic at 3.33%, only 1 species of Nudibranchia was found (Table 7).

Based on the 4 substrates that become the habitat of Nudibanchia on Samalona Island, Barranglompo Island and Badi Island, the substrates most occupied by Nudibranchia are Dead Coral Algae (DCA) and Algae, while on Sponge substrate there are only two species, namely *Phyllidia pustulosa* and *Pteraeolidia semperi*, on the abiotic substrate there is only *Goniobranchus coi*.

Nudibranchia also have self-defense abilities such as being able to camouflage and change body color according to food and environmental conditions (Darmawan, 2014). This ability is done to protect themselves from predators who want to prey on Nudibranchia so that they are able to maintain their species and population in nature. Nudibranchia species are strongly influenced by factors such as differences in habitat and food availability. The characteristics of the type of food are also very dependent on the ecosystem in which they live because Nudibranchia is a marine biota that has specific food characteristics, which means that each species of Nudibranchia has different types of food.

Table 8. Nudibranchia Substrat Conditions on Samalona Island, Barranglompo Island, and Badi Island

Family	Species	Substrate			
		DCA	Algae	Sponge	Abiotik
Phyllididae	*Phyllidia pustulosa*	+	+	+	-
	Phyllidia varicosa	+	+	-	-
	Phyllidiopsis xishaensi	-	+	-	-
Chromodoridae	*Chromodoris reticulata*	+	-	-	-
	Chromodoris geometrica	+	+	-	-
	Choromodoris annae	+	-	-	-
	Glossodoris atromarginata	+	+	-	-
	Glossodoris acosti	+	-	-	-
	Goniobranchus coi	+	-	-	+
	Hypselodoris tryoni	+	-	-	-
Kentrodorididae	*Jorunna funebris*	+	-	-	-
Aglajidae	*Pleasant chelidonura*	+	+	-	-
Facelinidae	*Pteraeolidia semperi complex*	+	+	+	-
	Total	12	7	2	1

Description: + (Yes), - (None)

Several types of substrate categories as Nudibranchia habitat found on each island (table 8) were divided into substrate types, namely Dead coral algae, Algae, Sponges, and Abiotics. Some species of Nudibranchia have the same substrate as other species and there is also the most dominant species of substrate occupied by Nudibranchia. This is because the type of food found in each Nudibranchia is the same type of food and some is different. The most dominating Nudibranchia substrate conditions were 12 species of Dead coral algae substrate, 7 species of Algae substrate, 1 species of Sponge substrate, and 1 species of Abiotic.

In general, Nudibranchia can eat algae, sponges, hard and soft corals, bryozoans, and hydroids (Pungus, 2017). When viewed from the type of food, Doridiidae members eat sponges, generally large in size, flat in shape, and capable of camouflage. Meanwhile, the hydroid eaters are dominated by Aeolididae (Yasman, 2003). The differences and similarities in the type of substrate occupied by each type of Nudibranchia were found due to their feeding behavior. According to Behrens (2005) states that Nudibranchia has one food source depending on the type of Nudibranchia. So it can be seen that each Nudibranchia has one specific type of food depending on the species of Nudibranch.

Several species of Nudibranchia were found on DCA, Algae, and Sponge substrates such as *Phyllidia pustulose* and *Pteraeolidia semperi* complex. *Phyllidia varicose*, *Chromodoris geometrica, Glossodoris atromarginata*, and *Pleasant chelidonura* species were found on DCA and Algae substrates. *Chromodoris reticulate, Choromodoris annae, Glossodoris acosti, Hypselodoris tryoni*, and *Jorunna funebris* species were only found on DCA substrates. *Phyllidiopsis xishaensi* was found on Algae substrate. For the species of *Glossodoris acosti* found on DCA and Abiotic substrates.

The species of Nudibranchia found on the DCA substrate may have a lot of encrusting sponges that cover the DCA or there are algae eaters such as Bryzoa or small hydroids on the DCA substrate so that they become Nudibranchia food. On algae substrates, the food may be algae or benthic animals attached to algae such as Bryzoa or small hydroids. Meanwhile, on the sponge substrate, the type found to be sponge-eaters or found on the surface of the sponge, small hydroids were found as food for Nudibranchia.

The availability of suitable substrate for Nudibranchia will provide a high survival rate, this substrate is used as a place to live, find food and breed. Changes in color and shape of Nudibranchia affect the type of substrate it occupies to trick themselves from predators who will eat them. In addition, Nudibranchia is known as a toxic biota (Fisch et al. 2017), this toxic substance can vary due to changes in diet, for example from one type of food to another, such as the type that occupies Dead coral algae, there are also those who inhabit Algae, and Sponges, or vice versa (Marpaung et al. 2019)

Environmental Parameter

Measurement of environmental parameters was carried out 3 three times in each island, namely Samalona Island, Barranglompo Island and Badi Island. Several environmental parameters measured in this study were Temperature, Salinity, Clarity, and Current Velocity which were carried out in March-April 2021, which are listed in table 9.

Table 9. Average Oceanographic Parameters measured in March-April 2021

Island	Environmental Parameters			
	Temperature (°C)	Salinity (ppt)	Clarity (%)	Current Speed (m/s)
Samalona	29.6 ± 0.38	30 ± 0.00	100 ± 0.00	0.15 ± 0.02
Barranglompo	30.6 ± 0.33	32.3 ± 0.38	100 ± 0.00	0.17 ± 0.02
Badi	29 ± 0.00	32 ± 0.19	100 ± 0.00	0.07 ± 0.006

Temperature measurement results on Samalona Island is 29.6°C, on Barranglompo Island it is 30°C, while on Badi Island it is 29°C. According to Sukarno (1995), the development of coral reefs and biota around coral reef ecosystems has optimal water temperature conditions ranging from 25-35 °C. Meanwhile, according to the Decree of the Minister of the Environment in 2004 concerning sea water quality standards for marine biota, namely coral, it ranges from 28 - 30 °C. The temperature for marine biota is in the range of 28-32 °C and changes are allowed up to < 2 °C from the natural temperature. The temperature obtained on each island is still very suitable for the habitat of Nudibranchia.

Salinity measurement results obtained on each island ranged from 30-32.3 ppt. The salinity value obtained is very suitable for survival because the optimal salinity range for Nudibrachia is between 30 ppt – 35 ppt (Kriegstein et al. 1974). According to the Decree of the Minister of the Environment in 2004 concerning sea water quality standards for coral marine biota, salinity suitable for the survival of Nudibranchia ranges from 33-34 ppt. Salinity is known to have an influence on the growth and development of Nudibranchia larvae. After hatching from eggs, Nudibranchia larvae develop into planktonic larvae for ± 44 days, where the optimum salinity for larval development is > 20 ppt (Chester, 1995).

The current speed obtained on Samalona Island and Barranglompo Island is classified as slow current, namely 0.15-0.17 m/s, while on Badi Island the current speed is classified as very slow current, namely 0.07 m/s. Current velocity can be grouped into three categories, namely very fast (>1 m/s), fast (0.5–1 m/s), moderate (0.25–0.5 m/s), slow (0. 1–0.2 m/s) and very slow (<0.1 m/s) (Risnawati et al., 2018). Current speed in each island is classified as very slow current, so it can be said that it is in the range for Nudibranchia life.

The brightness obtained on each island is 100% with an observation depth of 4-7 m. According to the Decree of the Minister of the Environment in 2004 concerning sea water quality standards for marine biota, the brightness for coral is > 5 meters. Brightness relates to light penetration. This factor is closely related to the availability of light and the level of brightness of the waters. According to Sukarno (1995), coral reefs cannot grow and develop at water depths of more than 50 meters. The

growth of corals and associated biota is limited by the depth associated with the penetration of sunlight into the waters.

CONCLUSION

Based on the results obtained, it can be concluded that Nudibranchia found on Samalona Island consisted of 4 families, 7 species and 36 individuals, on Barranglompo Island consisted of 4 families, 6 species and 51 individuals, and on Badi Island consisted of 3 families, 6 species and 30 individuals. individual. Meanwhile, the Nudibanchia diversity index found on each island is classified as a fairly stable to stable community structure so that it can be said that the water conditions are still good and the availability of food is still abundant on each island. The most common types of substrate occupied by Nudibranchia are DCA and Algae substrates.

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