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BIODIVERSITY OF MARINE TUNICATES IN SAMALONA WATERS, SANGKARANG ARCHIPELAGO, INDONESIA

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ABSTRACT

The study aims to know the biodiversity and community structure of marine tunicate in Samalona waters. The present study is part of biodiversity assessment for marine resources of Sangkarang Archipelago SW Makassar Indonesia. Field campaign was conducted from October to November 2016. Sample collection was done at 3 and 7 m depth by using Line Intersection Transect (LIT) method combined with a quadrat (plot). Two 50 m transects were placed parallel to a shore line at three stations (sta.) at Samalona waters. A quadrat (plot) (2.5 m x 2.5 m) was placed side by side of the line transect and all tunicates in the transect was recorded, identified, counted and photographed. Samples were collected by using SCUBA and under water camera. Environmental parameters including water temperatue, salinity, dissolved oxygen, clarity, current and wind speed, were measured *in situ*. Data were analysed using ecological indices including species composition and density, Shanon Wienner species diversity, Evenness, and Morisita Indices. The result indicates that there are 18 species of tunicates present at 3 m as well as 7 m depth of Samalona waters.. Result of the ecological analysis shows that species diversity can be categorized as moderate and there were no dominant species. Environmental parameters indicates that water quality at Samalona waters was in good condition to support tunicates.

Key words: ascidian, chordata, coral reefs, Spermonde

INTRODUCTION

Marine invertebrates as major group living incoral reefs of the Indo-Pacific region are rich for secondary metabolite and are targeted for studying lead compound as marine drug discovery (Sabdono and Radjasa 2008). Radjasa *et al* (2011) stated that coral reef ecosystem is a source for bioactive compound origin from its associated biotas such as sponge, ascidians, mollusks, bryozoans and cnidarian.

Biodiversity of marine biotas has pushed the discovery of marine natural products that can be developed as a therapeutics candidate. Marine tunicates were potential for inoculum source for endo-symbiotic that can produce anti-bacterial and anti-fungi (Karthikeyan *et al.* 2009; Litaay *et al.* 2015; Christine *et al*. 2015; Nurfadillah *et al*. 2015; Sardiani *et al*. 2015; Tahir *et al*. 2016). Tunicates are also potential antiviral (Murti and Agrawal, 2010), anticancer (Shaala and Youssef, 2015), inhibitor and induces apoptosis of breast (MCF-7; MDA-MB) cancer cells and also used for phase II cancer treatment (Zelek *et al*. 2006; Michaelson *et al*. 2012; Atmaca *et al*. 2013), as inhibitor of breast cancer cells by JNK dependent apoptosis (Gonzalez-Santiago *et al*. 2006), breast and prostate cancer (Kalimuthu *et al*. 2014). One of the bioactive compounds produced by tunicate is used to cure refractory soft-tissue sarcomas (Sinko *et al*. 2012). Sangkarang Archipelago which was previously known as Spermonde is located South West off Makassar, consisting more than a hundred islands. Various marine biodiversity in Sangkarang area have been studied (Moll 1983; Verheij 1993; Massin 1999; Renema and Simon 2001; de Voogd *et al*. 2006, Pogoreutz *et al*. 2012; Priosambodo *et al*.2014). However, diversity of marine tunicates in the Sangkarang region is less studied (Fikruddin, 2013; Mawaleda, 2014). In order to explore bio-prospecting of marine tunicate, a basic research on species diversity is needed. Information on biodiversity and distribution of tunicate in this region will provide useful baseline data to support sustainable use of marine resources.

MATERIALS AND METHODS

Sample Collection

Sampling of tunicates was done at three different sites (sta.) of Samalona waters, Sangkarang Archipelago South Sulawesi Indonesia (Figure 1). SCUBA was used in collecting sample and LIT

Figure 1. Location at Samalona waters, red spot indicating the sampling sites. sta 1 (5°7.390'S; 119°20.576'E), sta 2 (5°7.513'S; 119°20.330'E) and sta 3 (5°7.699'S; 119°20.506'E).

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at 3 m and 7 m depth at three stations (Figure 1). In each station, a 50 m line transect was placed parallel to shore line and a quadrat (2.5 m x 2.5 m) was applied side by side of transects. All tunicates in the quadrat were recorded, identified, counted and photographed. Sub-sample was taken and brought to laboratory for identification purposes. Environmental parameter was measured *in situ*. Underwater camera Canon GIS was used to obtain images of species and habitat (English *et al*. 1997; Brower at al. 1998). Water parameter including type of substrate, pH, temperature, current, salinity, clarity and dissolved oxygen were measured during sampling. Identification of tunicates was based on main morphological characters according to Kott (2005), Page and Kelly (2013), WoRMS (2017).

Data Analysis

Data analysis were based on ecological indices including density, Shanon Wiener diversity index, Dominance Index, Dispersion Index of Morisita (Odum, 1993) as follows

$$Di = ni / A$$

Where;
Di = Density species i
ni = Total no of individuals of species *i* in all quadrats
A = Total area of quadrats (plot)

Species composition = (No of individual sp-i /Total no of individual) x 100 %

Dominance Index (Odum, 1993)

$$C = \sum (ni / N)^2$$

Where;
ni = No of individual species *i*
N = Total no of individuals of all spesies
C = Dominance Index
Criteria **:**
$0 < C \leq 0.5$ = Low
$0.5 < C \leq 0.75$ = Moderate
$0.75 < C \leq 1.00$ = High

Shanon-Wiener Diversity Index

$$H = -\sum (ni / N) \ln (ni / N)$$

Where;
ni = Number of spesies - *i*
N = Total number of species
H' = Diversity Index
Criteria **:**
$0 < H' \leq 2.0$ = Low
$2 < H' \leq 3.0$ = Modertae
$3.0 < H' \leq 4.0$ = High

Morisita Index

$$Id = n \frac{\sum X^2 - N}{N(N-1)}$$

Where;
n = total number of plot/transect =∑F(x)
N = Total no of individual inside plot/transect = ∑[F(X)] (X)
∑X2 = Sum of the squares of the number of individual inside plot = ∑[F(X)] (X2)
Criteria **:**
Id < 1.0 = Randomly distributed
Id = 1.0 = Uniformly distributed
Id > 1.0 = Clumped distributed

Correspondance Analysis (CA) was used to observe the relationship between tunicates with water parameters (SPSS ver 23).

RESULTS AND DISCUSSION

Species Composition

The result shows that there are 18 species of tunicate present at reef flat (3 m) and reef slope (7 m) of Samalona waters (Table 1). The highest percentage of species diversity was found at 3 m depth at sta. 3 (83.3%) and lower in Sta 1 and 2 (77.2 %). At 7 m depth, we found similar number of tunicate species at sta. 2 and 3 (72,2%), yet higher compared to sta. 1. We recorded 7 families and number of species of tunicates (in brackets) as follows Clavelinidae (3), Didemnidae (3), Diazonidae (1), Styelidae (4), Ascidiidae (1), Perophoridae (3), Pyuridae (3) (Table 1).

Species Richness

The result of species richness is provided in Table 2. Table 2 shows that D. molle were more abundant at 3 m depth reef flat in all stations. This species is small in size, living solitary or forming a colony. Hence, D. molle can be found in a big colony at different habitats and depths. Previous finding indicated that Didemnum can grow at different habitats (Bullard and Whitlatch 2008; Carman *et al*., 2010).

Diversity, Morisita and Dominance Indices

Table 3 shows value of species diversity and Morisita indices at different sites and depths in Samalona waters. Based on criteria used in this study, diversity of tunicate is classified as low at 3 m depth at sta. 1 and sta. 2, while moderate at other depths and sites. Values of Morisita index indicates that tunicates are randomly distributed at all depths and sites (Table 3).

Table 4 shows the value of dominance index ranges from 0 to 0.68. High values were recorded for *Didemnum molle* at 3 m depth at sta. 2 as well as sta. 1. This indicates a moderate dominance of particular species at those sites. As also described in Table 4, value of dominance index was less than 0.5 or close to zero.

Table1. The occurrence of tunicates at different sites and depth of Samalona water

Tunicates Family & species	Sta 1		Sta 2		Sta 3	
	3 m	7 m	3 m	7 m	3 m	7 m
Clavelinidae						
Clavelina robusta Kott 1990 *(white spot)*	+	+	+	+	+	+
Clavelina lepadiformis Muller, 1776	+	+	+	+	+	+
Oxycornia fascicularis Drasche, 1882	-	+	+	+	+	+
Didemnidae						
Didemnum molle Hermann, 1986	+	+	+	+	+	+
Lissoclinum patella Gottschaldt 1898	-	+	-	-	+	-
Trididemnum della Ritter & Forsyth, 1917	+	+	+	+	+	+
Diazonidae						
Rhopalea crassa Hermann, 1880	+	+	+	+	+	+
Styelidae						
Polycarpa papillata Sluiter, 1886	+	+	+	+	+	+
Polycarpa aurata Quoys & Gaimard, 1834	+	+	+	+	+	+
Polycarpa nigricans Heller, 1878	-	+	+	+	+	+
Polycarpa spongiabilis Traustedt 1883	+	-	-	-	+	-
Ascidiidae						
Ascidia sydneinsis Monniot F. 1898	-	+	+	+	+	+
Perophoridae						
Pherophora sp (soft blue)	+	-	-	-	-	-
Pherophora sp (orange)	+	-	-	+	-	+
Perophora annectens Ritter, 1893	+	-	+	-	+	-
Pyuridae						
Pyura molina Blainville, 1824	-	+	-	-	+	+
Halocynthia verrill Dumosa Simpson, 1885	+	-	+	+	+	+
Microcosmus juinii Drasche 1884	+	-	+	-	-	-
Total percentage (%)	77.7	66.6	77.7	72.2	83.3	72.2

Table 2**.** Species richness at different sites and depths of Samalona waters (ind/500m^2)

No.	Tunicates species	Sta 1		Sta 2		Sta 3	
		3 m	7 m	3 m	7 m	3 m	7 m
1	*Clavelina robusta* Kott 1990 *(white spot)*	0.126	0.054	0.004	0.058	0.042	0.016
2	*Clavelina lepadiformis* Muller, 1776	0.04	0.014	0.008	0.004	0.372	0.04
3	*Oxycornia fascicularis* Drasche, 1882	0	0.03	0.006	0.054	0.052	0.03
4	*Didemnum molle* Hermann, 1986	2.286	0.79	2.16	0.564	0.872	0.416
5	*Lissoclinum patella* Gottschaldt 1898	0	0.028	0.012	0.036	0.026	0.004
6	*Trididemnum della* Ritter & Forsyth, 1917	0.01	0.002	0.048	0.012	0.012	0.008
7	*Rhopalea crassa* Hermann, 1880	0.012	0.01	0.002	0.032	0.01	0.014
8	*Polycarpa papillata* Sluiter, 1886	0.352	0.052	0.068	0.09	0.12	0.056
9	*Polycarpa aurata* Quoys & Gaimard, 1834	0.178	0.25	0.092	0.212	0.344	0.096
10	*Polycarpa nigricans* Heller, 1878	0.134	0.128	0.186	0.078	0.206	0
11	*Polycarpa spongiabilis* Traustedt 1883	0.008	0	0	0	0.01	0
12	*Ascidia sydneinsis* Monniot F. 1898	0	0.008	0.002	0	0.004	0.002
13	*Pherophora sp (soft blue)*	0.006	0	0	0	0	0
14	*Pherophora sp (orange)*	0.004	0	0.002	0	0.002	0
15	*Perophora annectens* Ritter, 1893	0.004	0	0	0.002	0	0.002
16	*Pyura molina* Blainville, 1824	0	0.132	0	0	0.094	0.024
17	*Halocynthia verrill* Dumosa Simpson, 1885	0.018	0	0.016	0.074	0.002	0.002
18	*Microcosmus juinii* Drasche 1884	0.002	0	0.002	0	0	0

Tabel 3. Value of Diversity and Morisita Indices

Sites	Depth (m)	Diversity Index	Morisita Index
Sta 1	3	0.99	0.35
	7	1.55	0.53
Sta 2	3	0.73	0.25
	7	1.68	0.58
Sta 3	3	1.67	0.57
	7	1.35	0.46

Table 4. The Result of Dominance Analysis

No	Tunicate Species	Sta1		Sta 2		Sta 3	
		3 m	7 m	3 m	7 m	3 m	7 m
1	*Clavelina robusta* Kott 1990 *(white spot)*	0.002	0.001	0	0.002	0	0.001
2	*Clavelina lepadiformis* Muller, 1776	0	0	0	0	0.029	0.003
3	*Oxycornia fascicularis* Drasche, 1882	0	0	0	0.002	0.001	0.002
4	*Didemnum molle* Hermann, 1986	0.517	0.278	0.686	0.215	0.162	0.343
5	*Lissoclinum patella* Gottschaldt 1898	0	0	0	0.001	0	0
6	*Trididemnum della* Ritter & Forsyth, 1917	0	0	0	0	0	0
7	*Rhopalea crassa* Hermann, 1880	0	0	0	0.001	0	0
8	*Polycarpa papillata* Sluiter, 1886	0.012	0.001	0.001	0.005	0.003	0.006
9	*Polycarpa aurata* Quoys & Gaimard, 1834	0.003	0.028	0.001	0.030	0.025	0.018
10	*Polycarpa nigricans* Heller, 1878	0.002	0.007	0.005	0.004	0.009	0
11	*Polycarpa spongiabilis* Traustedt 1883	0	0	0	0	0	0
12	*Ascidia sydneinsis* Monniot F. 1898	0	0	0	0	0	0
13	*Pherophora sp (soft blue)*	0	0	0	0	0	0
14	*Pherophora spp (orange)*	0	0	0	0	0	0
15	*Perophora annectens* Ritter, 1893	0	0	0	0	0	0
16	*Pyura molina* Blainville, 1824	0	0.008	0	0	0.002	0.001
17	*Halocynthia verrill* Dumosa Simpson, 1885	0	0	0	0.004	0	0
18	*Microcosmus juinii* Drasche 1884	0	0	0	0	0	0

Environmental Parameters

The range of environmental parameters in study sites (Table 5) are as follows: temperature 30-31^{o}C, salinity 31-32.5$^o/_{oo}$, dissolved oxygen (DO) 6.1-6.2 ppm, wind velocity 5.3-10.5 km/h), current 0.1-1.1 km/h, clarity 8.2-11.2 m, and pH 8.4. In general, water parameters are preferable for marine invertebrates.

Table 5. Environment parameters at Samalona waters

Water Parameters	sta 1	sta 2	sta 3
Temperature ^{o}C	31	30	30
Salinity $^o/_{oo}$	31	31.3	32.5
DO (ppm)	6.2	6.2	6.1
Wind Velocity (km/h)	10.5	9.8	5.3
Current (km/h)	0.1	1.1	0.7
Clarity (m)	8.2	10	11.2
pH	8.4	8.4	8.4

Relationship Between Tunicates With Environment Parameters

The result of Correspondence Analysis (CA) between species composition and environmental parameters is given in Figure 2.

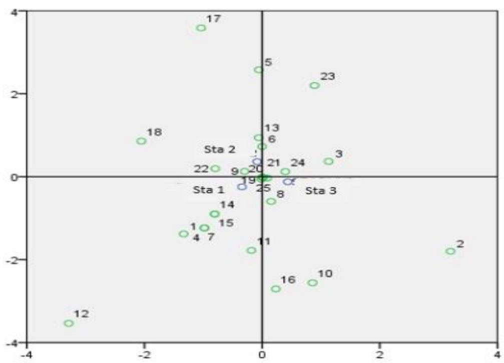

Figure 2. The relationship between species composition with environmental parameters (Note: 1-18 tunicates species as indicated in Table 1; 19 = temperature, 20 = salinity, 21 = DO, 22 = wind velocity, 23 = current, 24 = clarity, 25 = pH)

As shown in figure 2, distribution of most of the tunicate are related to environmental parameters as they are close to center of the quadrant. While *Clavelina lepadiformis* (2), *Ascidia sydneinsis* (12), and *Halocynthia verrill* (17) are different compare to other ascidians as indicated in Figure 2. These species were found solitary living amongst brain coral (*A. sydneinsis*), *H. verrill* in small size and abundant at 3 m. This may indicate that other factors may influence the distribution of these particular tunicates.

Tunicates from Sangkarang archipelago is less documented. This study was the first record for marine tunicate from Samalona waters of this archipelago. This study indicates that a number of tunicate species for this area is less than recorded from Baranglompo island of Sangkarang. Mawaleda (2014) found 33 species of tunicates at coral reef areas of Baranglompo waters. However, this study shows more tunicates species are found in Samalona waters compared to those recorded for other islands of Sangkarang: 7 species (Lae-Lae), 9 species (Bone Batang) and 10 species (Badi) waters (Fikruddin, 2013). Tunicate class Ascidiacea is the most diverse group, as 700 species have been recorded in the Australian waters, while Thaliacea is having less than 100 species worldwide and Appendicularia is about 60 species known worldwide (Kott, 2005). Kiuru *et al*. 2014 estimated that marine and coastal environments host about 90% of all organisms living on earth. Here, we found 18 species tunicate at Samalona waters, this number is still low compare to a worldwide known tunicates.

Marine resources particularly in coastal areas and small islands received main pressure from natural catastrophic and anthropogenic activities. Human activities in main land as use of unfriendly fishing method, overfishing, pollution , coastal development and global warning has have big impact on marine resources. These also can contribute to loss of biodiversity of marine resources. Sangkarang archipelago has more than a hundred islands, biodiversity of tunicates in this area are still questionable. Therefore, more studies on biodiversity of tunicates in this area is needed.

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