Marine tunicates from Sangkarang Archipelago Indonesia: recent finding and bio-prospecting

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Abstract. Tunicate belongs to urochordata that inhabit benthic area of coral reefs. This paper attempts to compile result of several studies on diversity of marine tunicates from Sangkarang Archipelago of South Sulawesi Indonesia. Method for tunicates sample collection was line transect method that applied at two 3 and 7 m depth. A 50 m line transect was applied parallel to a shore line in each depth and was done in duplicate. A 2.5 m plot was places side by side of transect, in which all tunicate inside plot was counted, identified, and photographed, respectively. Tunicates identification was based on morphological characteristics. The latest finding shows that eighteen species of tunicates were recorded in Samalona waters as also the same number of species in Barrang Caddi waters. The result from this finding was compared to previous studies done at other part of Sangkarang area. This study concluded that this archipelago is rich in tunicates and these resources can be utilized for various purposes. Bio-prospect of marine tunicates is also discus in the present study.

1. Introduction
Coral reefs are known as tropical marine natural resources, hence habitat for various marine biotas. An annual review by expert on tropical natural resourced argued that this unique ecosystem is source for bioactive compound origin from its associated biotas such as sponge, ascidians, molluscs, bryozoans, cnidarian [1]. Marine invertebrates as major group living at coral reefs of Indo-Pacific region rich for secondary metabolite and are targeted for studying lead compound as marine drug discovery [2].

Amongst marine invertebrates, sponge is better known for their secondary metabolite and extensively studied [3-11]. Other invertebrate that may have potential in producing active compound is far less studied compared to sponge. Biodiversity of marine biotas has pushed discovery marine natural material that can be developed as a therapeutics candidate [11]. Some examples of marine natural product, tarabine, Ara-C and vidarabine Ara-A have been used to cure human diseases [12].

In order to explore bio-prospecting of marine biota, a basic research to know species diversity and distribution is needed. Sangkarang archipelago which is also known as Spermonde archipelago is located in South-west of Makassar, capital city of South Sulawesi province of Indonesia. In comparison with previous funding in marine biodiversity in Sangkarang area [13-19], diversity of marine tunicates in the Sangkarang region is less studied [20-23]. Information on biodiversity and distribution of tunicate in this region will provide useful baseline data to support sustainable use of...
marine resources. This article aims to update information on marine tunicates from this area based on a recent finding and literature review from several sources.

2. Materials and Methods

2.1 Data Sources
Data was obtained from the result from different studies in Sangkarang Archipelago (figure 1). A similar method was applied for sample collection in all studied. SCUBA was used to collect sample and LIT method combination with plot was applied at 3 m and 7 m depth at three stations (figure 2). In each station, a 50 line transect was placed parallel to shore line and plot size 2.5 m x 2.5 m was applied side by side of transects (figure 2). All tunicates inside plot was noted, identified, counted and photographed. Sub-sample was taken and brought to laboratory for further study. Environmental parameters were measured in situ. Underwater camera was used to obtain images of species and habitat [24,25]. LIT method combination with plot was similar with one applied by [20-21] and [22-23]. Identification of tunicates was based on a main morphological character according to [26-28].

Figure 1. Sangkarang Archipelago South Sulawesi Indonesia (★ location of data sources)
3. Result and Discussion

3.1 Distribution of marine tunicate

The latest finding on tunicate species composition in Sangkarang Archipelago indicates that number of species found as follows Samalona (18) [23], Barrang Caddi (18) [22]; Barranglompo (23) [21]; Lae-lae (7), Bone Batang (9), and Badi (10) [20] (table 1). In comparison with neighbor region, [29] has reported the number of ascidian records for Singapore to a total of 50. They also reported that 155 species were recorded from the South China Sea. [30] has documented close to 3000 species of ascidian worldwide. Furthermore, [31] have estimated there may be as many as 1500-2000 ascidian species worldwide still to be discovered and named. In the present study, as described in table 1, even though Sangkarang area is rich in marine tunicates, more studied still need to be carried out.

Table 1. List of Tunicates from different location in Sangkarang Archipelago Indonesia.

| No. | Tunicate                                           | Samalona a) | Barrang Caddi b) | Barrang Lompo c) | Lae-lae d) | Bone-Batang e) | Badi f) |
|-----|---------------------------------------------------|-------------|-----------------|-----------------|-----------|----------------|--------|
| 1   | Clavelina robusta Kott 1990 (white spot)          | √           | -               | -               | -         | -              | -      |
| 2   | Clavelina lepadiformis Muller, 1776               | √           | √               | -               | -         | -              | -      |
| 3   | Clavelina sp.                                     | -           | √               | -               | √         | √              | √      |
| 4   | Clavelina arafuensis                              | -           | -               | -               | -         | -              | -      |
| 5   | Clavelina moluccensis                             | -           | -               | -               | -         | -              | -      |
| 6   | Eudistoma sp.                                     | -           | √               | -               | -         | -              | -      |
| 7   | Eudistoma gilboviride                             | -           | -               | -               | -         | -              | -      |
| 8   | Eudistoma reginum                                 | -           | -               | -               | -         | -              | -      |
| 9   | Oxycornia fascicularis Drasche, 1882              | √           | √               | -               | -         | -              | -      |
| 10  | Nephtheis fasicularis                             | -           | -               | √               | -         | -              | -      |
| 11  | Didemnids sp. (brown white)                       | -           | -               | -               | -         | -              | -      |
| 12  | Didemnids sp. (purple)                            | -           | -               | √               | -         | -              | -      |
| 13  | Didemnum molle Hermann, 1986                      | √           | √               | √               | √         | √              | √      |
| 14  | Didemnids sp.                                     | -           | -               | -               | -         | -              | -      |
| 15  | Didemnids sp. (white)                             | -           | √               | -               | -         | -              | -      |
| 16  | Didemnum sp.                                      | -           | √               | -               | -         | -              | -      |
| 17  | Tridemnum della Ritter & Forsyth, 1917            | √           | -               | -               | -         | -              | -      |
| 18  | Tridemnum sp.                                     | -           | √               | -               | -         | -              | -      |
| 19  | Lissoclinum patella Gottschaldt 1989              | √           | -               | √               | -         | -              | -      |
| 20  | Diplodosoma simile                                | -           | -               | √               | -         | -              | -      |
3.2 Bioprospecting of marine tunicates

Sangkarang Archipelago is located South West off Makassar, consisting more than hundred islands, hence having abundant marine natural resources. This area hold importing role as habitat for various marine biotas including tunicates. Previous studies indicates that marine tunicates were potency for inoculum source for endo-symbiotic bacteria that can produce anti-bacterial and anti-fungi [7,32,33]; [34-36]. Other studies has also indicated that tunicates are also had a potency as antiviral [37], anticancer [38], inhibit and induces apoptosis of breast (MCF-7; MDA-MB) cancer cells and also used for phase II cancer treatment [39-41], as inhibits breast cancer cells by JNK dependent apoptosis [42], breast and prostate cancer [43]. Yondelin one of bioactive compound produced by tunicate is use to cure refractory soft-tissue sarcomas [44].

References
[1] Radjasa OK, Vaske YM, Navarro G, Vervoort HC, Tenney K, Linnington RG and Crews P 2011 Highlights of marine invertebrate-derived biosynthetic products: Their biomedical potential and possible production by microbial associants. Bioorganic & Medicinal Chemistry 19 6658–74

21 Diplosoma sp. √ - - √ - -
22 Polycarpa aurata Quoys & Gaimard, 1834 √ √ √ √ √ √
23 Polycarpa captiosa - - - - - -
24 Polycarpa contecta - - √ - - -
25 Polycarpa sp. - - √ - - -
26 Polycarpa sp. (brown) - - - - - -
27 Polycarpa sp. (white dots) - - √ - - -
28 Polycarpa papillata Sluiter, 1886 √ √ - - √ -
29 Polycarpa nigricans Heller, 1878 √ - - - - -
30 Polycarpa spongabilis Traustedt 1898 √ - - - - -
31 Ascidia sp. (brown) - - √ - - -
32 Ascidia krea guaran - - √ - - -
33 Ascidia sp. (blue) - - √ √ √ √
34 Ascidia sp. - - √ - - -
35 Ascidia ornate - - √ - - -
36 Ascidia sydneensis Monniot F. 1898 √ - - - - -
37 Diazona sp. - - √ - - -
38 Nephtheis fasicularis - - √ - - -
39 Rhopalaea sp. (blue) - - - - - -
40 Rhopalaea sp. (yellow spot) - - √ - - -
41 Rhopalaea sp. - √ - √ - -
42 Rhopalaea crassa √ - - √ √ -
43 Rhopalaea abdominalis - - - - - -
44 Herdmania momus - - √ - - √
45 Pyura molina Blainville, 1824 √ - - - - -
46 Pyura sp. - √ √ - - -
47 Halocynthia verril Dumosa Simpson, 1885 √ - - - - -
48 Halocynthia sp. - √ - - - -
49 Microcosmus juinii Drasche 1884 √ - - - - -
50 Plurella sp. - - √ - - -
51 Atriolum robustum - - - - √ √
52 Botyllus sp. - √ - - √ -
53 Pherophora sp. (soft blue) √ - - - - -
54 Pherophora sp. (orange) - - - - - -
55 Perophora annectens Ritter, 1893 √ - - - - -

Note: [23]; [22]; [21]; [20]; [20].
√ = present - = absent
[2] Sabdono A and Radjasa OK. 2008. Microbial symbionts in marine sponges: Marine natural product factory. *J Coast Dev*. **11** 57–61

[3] Bugni TS and Ireland CM 2004 Marine derived fungi: a chemically and biologically diverse group of microorganisms. *Nat. Prod. Rep.* **21** 143–63

[4] Thakur NL and Müller MEG 2004 Biotechnological potential of marine sponges. *Curr. Sci.* **86** 1506–1512

[5] Wang G. 2006. Diversity and biotechnological potential of the sponge-associated microbial consortia. *J. Ind. Microbiol. Biotechnol.* **33** 545–51

[6] Jackson, K 2009 The Halichondrins and E7389 *Chem. Rev.* **109** 3044–79

[7] Karthikeyan MM, Ananthan G and Balasubramanian T 2009 Antimicrobial Activity of Crude Extracts of Some Ascidians (Urochordata: Ascidiacea), from Palk Strait, (Southeast Coast of India). *World J. of Fish and Mar. Sci*. **1** (4) 262-7

[8] Kennedy JP, Baker C, Piper PD, Cotter M, Walsh MJ, Mooij MB, Bourke MC, Rea, O’Connor PM, Ross RP, Hill C, O’Gara F., Marchesi JR and Dobson ADW 2009 Isolation and analysis of bacteria with antimicrobial activities from the marine sponge *Halichondra simulans* collected from Irish waters. *Mar. Biotechnol.* **11** 384–96

[9] Kuznetsov G 2009 Tubulin-based antimitotic mechanism of E7974, a novel analogue of the marine sponge natural product hemiasterlin. *Mol. Cancer Ther* **8** 2852–60

[10] Li, Z. 2009. Advances in marine microbial symbionts in the China Sea and related pharmaceutical metabolites. *Mar. Drugs*, 7: 113–129

[11] Thomas TRA, Kavlekar DP and LokaBharathia PA 2010 Marine Drugs from Sponge-Microbe Association—A Review *Mar. Drugs* **8** 1417-1468; doi:10.3390/md8041417

[12] Mayer AMS, Glaser KB, Cuevas C, Jacobs RS, Kcm, W, Little R, McIntosh JM, Newman DJ, Potts BC and Shuster DE 2010 The odyssey of marine pharmaceuticals: a current pipeline perspective. *Trends in Pharmaceutical Sci*. **31** 255-65

[13] Moll H 1983 Zonation and diversity of scleractinian on reefs of South Sulawesi Indonesia. [Thesis]. Netherland: Leiden University

[14] Verheij E 1993 Marine plants on the reefs of the Sangkarang Archipelago, SW Sulawesi, Indonesia: aspect of taxonomy, floristics and ecology. [Dissertation] Leiden: Rijksherbarium/Hortus Botanicus

[15] Massin 1999 Reef Dwelling Holothuroidea (Echinoder mata) of The Sangkarang Archipelago (South-West Sulawesi, Indonesia). *Zoologische Verhandelingen* 329. National Natuurhistorisch Museum. Leiden

[16] Renema WT and Simon R 2001 Larger foraminifera distribution on a mesotrophic carbonate shelf in SW Sulawesi (Indonesia). *Palaeogeography, Palaeoclimatology, Palaeoecology* **175** 125-46

[17] de Voogd NJ, Cleary DFR, Hoeksema BW, Noor A and van Soest RWM 2006 Sponge beta diversity in the Sangkarang Archipelago, SW Sulawesi, Indonesia. *Mar. Ecol. Prog. Ser.* **309** 131–42

[18] Pogoreutz C, Kneer D, Asmus H, Anelt H and Litaay M 2012 The influence of canopy structure and tidal level on fish assemblages in tropical Southeast Asian seagrass meadows. *Eustarine Coastal and Shelf Science* **107** (2) 58-68

[19] Priosambodo D, Kneer D, Asmus H, Zamani NP, von Juterzenka K, Litaay M, and Soekendarsi E 2014 Community analysis of burrower shrimp in Bone Batang seagrass bed South Sulawesi. Proceeding of The First International Conference on Science (ICOS-1) 2014 ISBN 978-602-72198-0-9: 209 -219

[20] Fikruddin MBAdbD 2013 Distribution and diversity of Tunicate (Asciidiacea) at different habitat at waters of Badi, Bonebatang and Laelae Island. BSc Hon Thesis FIKP Hasanuddin University [Indonesian]

[21] Mawaleda R 2014 Distribution and habitat preference Urochordata class Ascidacea at coral reefs area of Barrang Lompo island of Makassar. BSc Hon Thesis B.ScHon FIKP
Hasanuddin University [Indonesian]

[22] Litaay M, S Johannes E, Santosa S, Moka W, Tanjung J D and Annas B. 2017. Diversity of tunicate from Barrang Caddi waters. Presented at the 4th International Marine and Fisheries Symposium, Makassar 18 May 2017

[23] Litaay M, Santosa S, Johannes E, Agus R, Moka W and Tanjung JS. 2018. Biodiversity of marine tunicate from Samalona waters off Indonesia. Spermonde J Mar. Sci. 3 (1). In press

[24] English S, Wilkinson C and Baker V 1997 Survey Manual for Tropical Marine Resources. Australian Institute of Marine Science. Townsville

[25] Brower JE, ZR JH and Von Ende CN 1998 Field and Laboratory Methods for General Ecology, Mc Graw Hill Company

[26] Kott P 2005 Catalogue of Tunicata in Australian Waters. Queensland Museum, Brisbane, Australia. ISBN 0 642 56842 1. 301 p

[27] WoRMS. 2017. World Register of Marine Species http://www.marinespecies.org/aphia.php?p=taxdetails&id=146420

[28] Shenkar N and Swalla BJ 2011 Global diversity of Ascidiacea. PloS ONE 6(6):e20697. doi.10.1371/journal.pone0020657

[29] Litaay M, Christine G, Gobel RB and Dwyana Z 2015 Bioactivity of endosymbiont bacteria of tunicate Polycarpa aurata as antimicrobial. In: Ohee (eds) Proceeding of The 23 National Seminar of Indonesia Biology Society. Jayapura, 18 September 2015. [Indonesian]

[30] Sardiani N, Litaay M, Gobel RB, and Haedar N 2015 Potency of tunicate Polycarpa aurata as inoculum source of bacterial inoculum that produce antibacterial; isolates characterization. J. Alam dan Lingkungan 6 (12) 10-6 [Indonesian]

[31] Sardiani N, Litaay M, Gobel RB, and Dwyana Z 2015 Potency of tunicate Rhopalaea sp as source of bacterial inoculum that produce antibacterial; isolates characterization. J. Alam dan Lingkungan 6 11 [Indonesian]
[36] Tahir E, Litaay M, Gobel RB, Haedar N, Prisambodo D and Syahribulan. 2016 Potency of tunicate *Rhopalaea crassa* as inoculum source of endosymbiotic fungi that produce antimicrobe. *J Mar. Sci. Sangkarang* 2 33-7 [Indonesian]

[37] Murti Y and Agrawal T 2010 Marine derived pharmaceuticals development of natural health products from marine biodiversity. *Int. J of Chem. Tech. Res.* 2 (4) 2198-217

[38] Shaala LA and Diaa Youssef TA 2015 Identification and Bioactivity of Compounds from the Fungus Penicillium sp. CYE-87 Isolated from a Marine Tunicate. *Mar. Drugs* 13 1698-709; doi:10.3390/md13041698

[39] Zelek L, Yovine A, Brain E, Turpin F, Taamma A, Riofrio M, Spielmann M, Jimeno J and Misset J 2006 A phase II study of Yondelis®(trabectedin, ET 743) as a 24-h continuous intravenous infusion in pretreated advanced breast cancer. *Brit. J Cancer* 94

[40] Michaelson M, Bellmunt J, Hudes G, Goel S, Lee R, Kantoff P, Stein C, Lardelli P, Pardos I and Kahatt C 2012 Multicenter phase II study of trabectedin in patients with metastatic castrationresistant prostate cancer. *Annals of Oncology* 23 1234-40

[41] Atmaca H, Bozkurt E, Uzunoglu S, Uslu R and Karaca B 2013 A diverse induction of apoptosis by trabectedin in MCF-7 (HER2-/ER+) and MDA-MB-453 (HER2+/ER-) breast cancer cells. *Toxicology Letters* 221 128-36

[42] Gonzalez-Santiago L, Suarez Y, Zarich N, Munoz-Alonso M, Cuadrado A, Martinez T, Goya, Iradi A, Saez-Tormo G and Maier J 2006 Aplidin® induces JNK-dependent apoptosis in human breast cancer cells via alteration of glutathione homeostasis, Rac1 GTPase activation, and MKP-1 phosphatase downregulation. *Cell Death & Differentiation* 13 1968-81

[43] Kalimuthu S, Venkatesan J and Se-Kwon k 2014 Marine Derived Bioactive Compounds for Breast and Prostate Cancer Treatment: A Review. *Current Bioactive Compounds* 10 62-74

[44] Sinko J, Rajchard J, Balounova Z and Fikotova L 2012 Biologically active substances from water invertebrates: a review. *Veterinarni Medicina* 57 (4) 177–84