

Diversity of Stoloniferan Coral (Stolonifera) at Lirang Island, Southwest Maluku (Moluccas), Indonesia.

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Abstract

Southwest Maluku (Moluccas) lied in the center of maximum marine tropical biodiversity in the world. About 605 hermatypic coral and 15 regional endemic coral are reminded in this area. *Tubipora musica* has unique skeleton with a dark red color that was came from combination iron and calcium organic complex. It's beautiful color to be main reason that *T. musica* continuing exploited as aquarium, jewelry and curio trade. Since 2001's IUCN categorized *T. musica* as threated and under appendix I and II. Using photo quadrat transect 1x1 m this research give clearly picture the distribution and condition of *T. musica* in Lirang Island that located in the hot spot of coral reef in the world. About 379 colonies of *T. musica* has been monitored that 87.33% of them in health condition.

Keywords: Organ pipe; *Tubipora musica*; coral triangle; biology population; coral disease; life form

INTRODUCTION

Octocorallia is a subclass of Anthozoa, that has cylindrical body with feather like tentacle (hollow tentacles) by 8. Another feature of Octocorallia's body frame is composed of calcium carbonate with a microscopic size that called sclerites [1]. This subclass is divided into several orders including stolonifera (organ pipe coral), *Alcyonacea*, *Helioporacea* (blue coral), Gorgonacea and Pennatulacea (sea pens) [2]. However, based on the latest taxonomy Octocorallia divided into three simple orders they were: Helioporacea, Pennatulacea (sea pens) and Alcyonacea (soft corals, organ pipe corals and gorgonians) [3]. Helioporacea has only one species, the blue coral, *Heliopora coerulea* in Indo-Pacific region and the genus *Epiphaxum* (Lethoteletidae) on Caribbean waters. Skeleton of *H. coerulea* is not composed of calcium carbonate, but composed from aragonite fibrocristalline makes the skeleton remains blue even though already dead [4].

Pennatulacea characterized by having primary polyps called oozoid, second polyps called autozooids and siphonozooids and third polyps called mesozooids. In the Indo-Pacific region, this order has 9 different genera of 5 families and mostly found live sandy or muddy bottom of waters so that are categorized as soft bottom substrate. Alcyonacea has the largest distribution of species of this order, estimated at Indo-Pacific region there are 100 genera from 23 families [5].

Stolonifera includes six families in which polyps are connected basally by stolons or thin membranes. One of them came is Tubiporidae that only one species that is *Tubipora musica* (organ pipe coral). The life form of *T. musica* is sometimes thick massive and encrusting when growth form is not perfect. Polyp of this coral form a tubular with solid skeleton has a distinctive red color, tubes are connected to one another by a horizontal canal. *T. musica* has varied size with a diameter <20 cm to 50 cm. The red color skeleton of *T. musica* difficult to identify because usually covered by their gray tentacles. Naturally, this coral lives in reef flat area canal or lagoon that protected from direct current [6].

Soft coral has five families in group Alcyoniina, polyps are embedded within a fleshy mass of coenenchymal tissue [7]. The primary morphological characters that have been used to define families of Alcyonacea are the overall growth forms of colonies, details of the composition of the skeletal axis (if present), and the shape and arrangement of sclerites (free skeletal elements embedded in the tissue of polyps and coenenchyme [8].

Distribution *T. musica* and soft corals in the waters of Indonesia is not known clearly, some of the literature only noted that Octocorallia can be found in the Indo-Pacific region in the shallow water [9; 10]. Generally, Octocorallia can be found in shallow water, rocky wall and coral reef environments of the world. They are a widespread group, occurring from the littoral down to the deep-sea abyss and from the Arctic to the

Antarctic oceans [5]. In the Great Barrier Reef, Octocorallia has a wide distribution or the second wider after hard coral [4; 5].

There are two species of Octocorallia now on the IUCN red list so that any form of trade was banned, *T. musica* and *Heliophora corualea* are in this category. Two types of this Octocorallia has very high demand in the market either alive or dead as the aquarium ornament and gift. Over-exploitation of types these corals will have an impact on decreasing or even will lose of these species from natural habitats. While soft coral existence is also threatened by climate change, destructive fishing, and pollution [11].

Lirang Island is located in Southwest Maluku and be in the Coral Triangle that has highest coral reef biodiversity in the world. The coral reefs in Pulau Lirang categorized as a fringing reef, where scleractinian coral occupied from 2 into 15 m depth. While the distribution of *T. musica* and soft coral in this area has never been used as a concern by the researcher, possibility due to difficulties of transportation to get to this island. The purpose of this study is to know the distribution of *T. musica* and soft coral for the data base of coral reef biodiversity on Coral Triangle.

MATERIALS AND METHODS

Place and study site

The survey was conducted on April 6 to 26, 2016 in Lirang Island Southwest Maluku, Indonesia. *T. musica* distribution data was conducted at 6 research stations. Determined by purposive sampling, assuming represent all areas of coral reefs in Lirang Island. Station 1 (S 08° 00' 56.0"; E 125° 45' 50.6") and 2 (S 08° 01' 03.3"; E 125° 46' 16.7") were located in the east of the island, the station 3 (S 7° 58' 51.92"; E 125° 43' 12.60") was located to the south of the island, station 4 and 5 (S 08° 03' 21.8" E 125° 44' 31.9" and S 8° 3' 7.85"; E 125° 44' 55.68) were located in the west of the island and the station 6 (S 07° 57' 55.3" E 125° 44' 55.2") was in the north of the island (Figure 1).

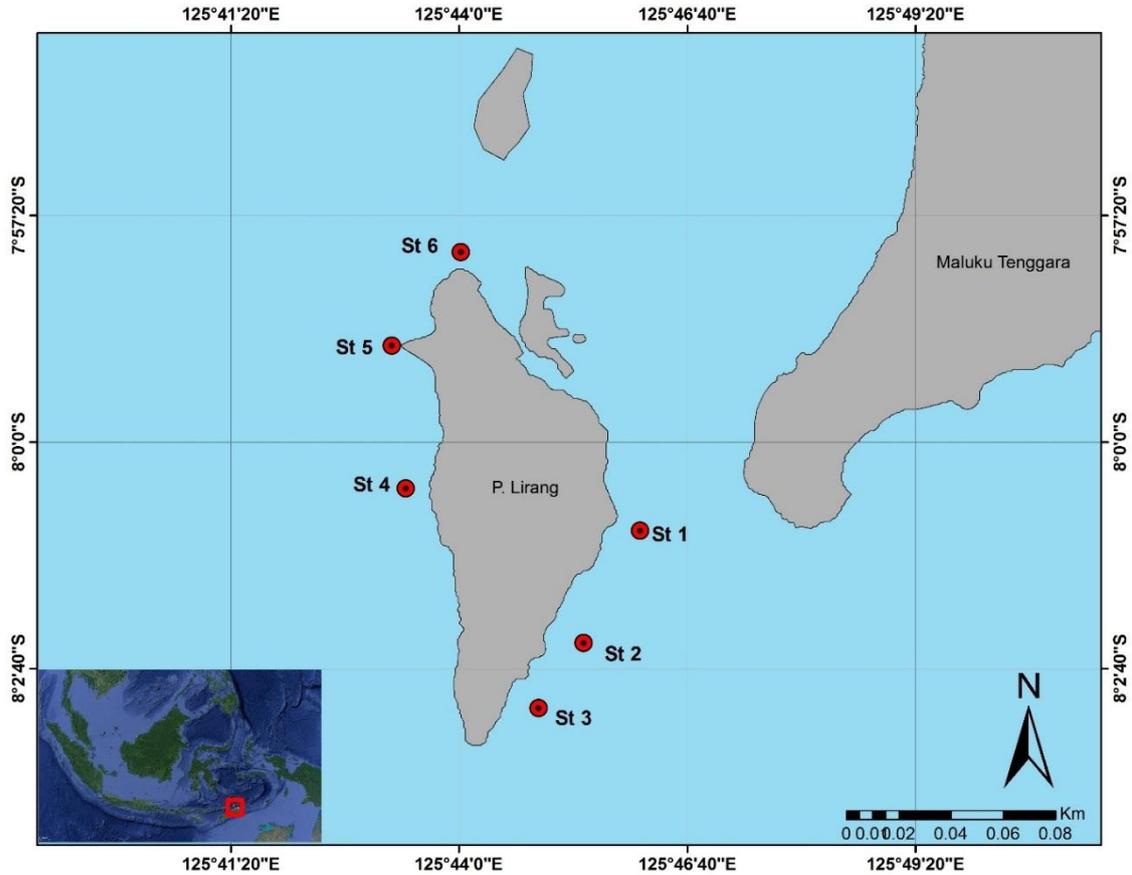


Figure 1. Survey site in Lirang, Island, Southwest Maluku

Data collection

Data were taken on coral reef area about 3-6 m depth, used belt transect 1x100 m parallel to the shoreline [12]. To facilitate the retrieval of data, we used quadrat transect 1x1 m and divided into 4 sub-plot of 50x50 cm. Each sub-plot was photographed using an underwater digital camera Canon G-16 (Japan). The image data of each sub-plot transects were then corrected using ACDSee Pro Ver. 8.2 and calculated the wide of colonies *T. musica* and soft coral using Image-J (NIH-USA).

A colony of *T. musica* by then recorded as octocorallia massive (OM) if colony stand alone and skeleton have similar dimension; octocorallia thick encrusting (OTE) if colony flatter [4]. The health colony (H) is living colony without lesion, broken 1 (B1) is less half colony broken or death any causes, broken 2 (B2) is equal or more half of colony broken and death (D) is no living tissue in the colony and the structure still in one entity. The surface area of the *T. musica* colony was estimated using hemisphere as interpreted from massive form according to Nauman [13]. The formula as below:

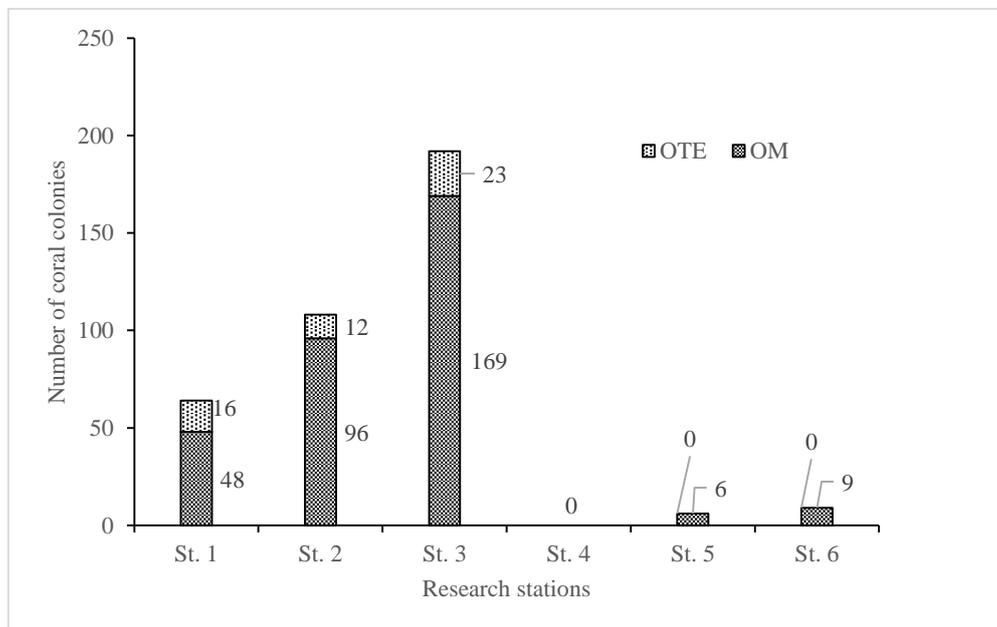
$$A = 2 \pi r^2 \quad (1)$$

Where: A = Area, Π = pi, r = radius;

RESULTS

Distribution of *T. musica* Life Form

Based on survey in six stations total about 379 colonies of *T. musica* has been found. Two types of life found was observed, massive (OM) and thick encrusting (OTE). OM was dominated form (328 colonies) than OTE (51 colonies) in Lirang Island. The highest colonies of *T. musica* has been found in station 3, 192 colonies, and the fewest in station 5 was 6 colonies (Figure 2). High colonies distribution was found in eastern part of Lirang Island (station 1-30) and low distribution in west side of island (stations 4-6). From figure 2 also can be seen the OTE form only found in the east part island, the opposite area only has 1 life form that was OM.



OTE: *Octocorallia Thick Encrusting*; OM: *Octocorallia Massive*.

Figure 2. Distribution of *T. musica* 's according to its life form

Class frequency

Size surface area frequency *T. musica* dominant in range 0-500 cm² with 326 colonies, this range also called as juvenile phase. In adult or mature size (> 2000 cm²) the colony only found 2 (Figure 3). Size distribution in figure 3 showed many small colonies of *T. musica* in Lirang Island, the number of colonies decrease from small class to high class.

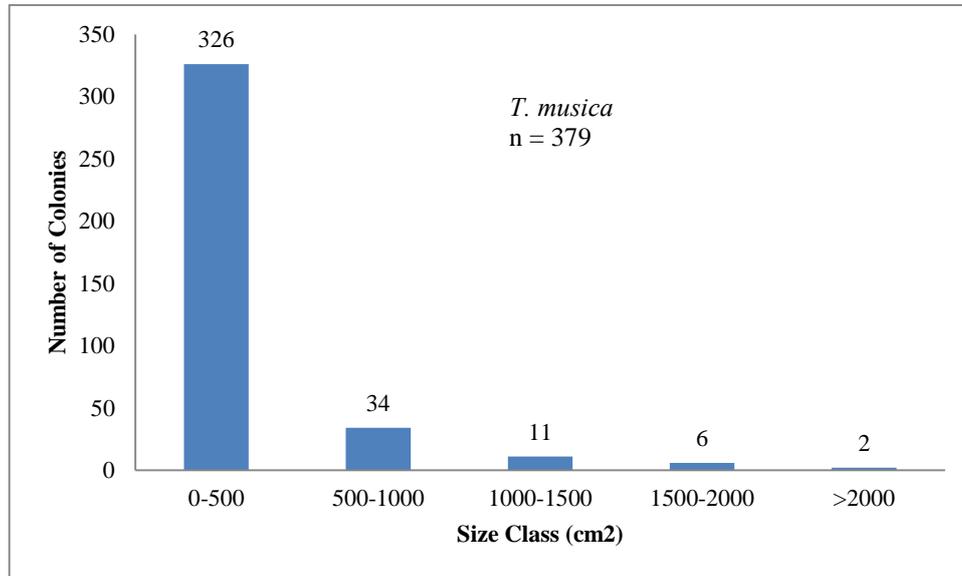


Figure 3. Size surface area's frequency distributions *T. musica* measured from 6 stations in Lirang Island.

Condition of *T. musica* in Lirang Island

Total health (H) of *T. musica* was 87.33%, broken 1 (B1) was 2.63%, broken 2 (B2) was 6.33% and death (D) was 3.69%. The highest health condition of *T. musica* was found in station 3 (43.27%) and the lowest was in station 5 (1.58%) (Figure 4). Low health condition was in station 5 and 6, it was 1.58% and 2.37%.

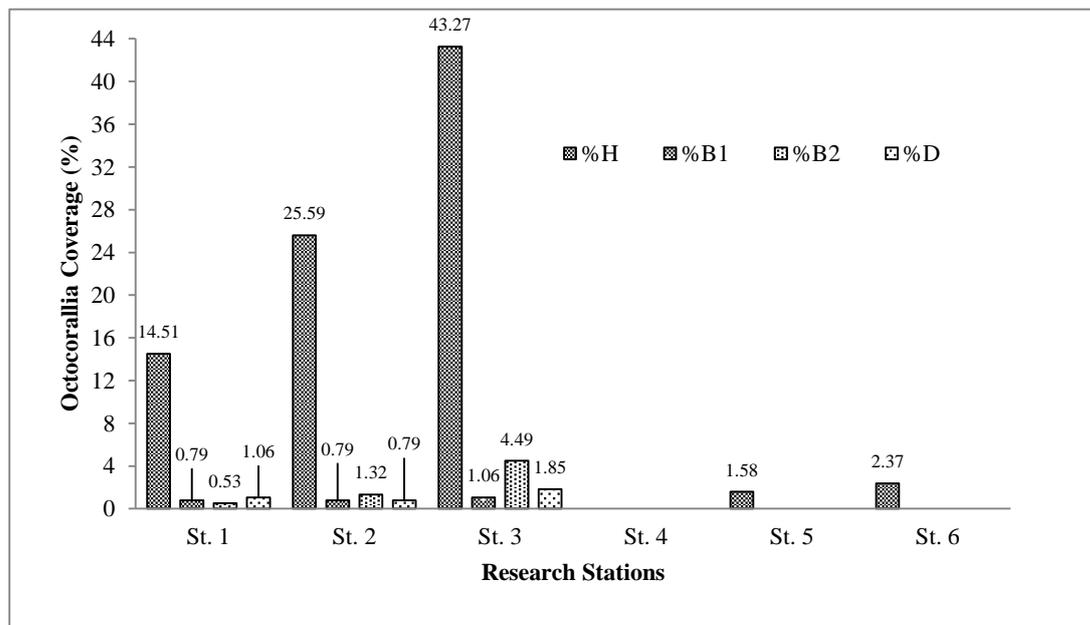


Figure 4. Health condition of colony *T. musica* in Lirang Island

DISCUSSION

Life form of *T. musica*

Coral life form has synonymous words such as growth form or morphology was described as overall of coral shape in a colony [4; 14]. Octocorallia massive means solid colony and have the similar dimension in all direction (spherical like the ball), if colony became flatter, it was called as encrusting. Thick encrusting it means the colony adhering the substrate and not followed the substrate contour while thin encrusting followed the substrate contour.

Morphology all types of hard coral (scleractinia) will be influenced by two things, environmental and genetic factors, it was in Octocorallia, the differences in the shape of coral growth (life form) in a species called a polymorphism. In normal condition *T. musica* have dome shaped but in this study, *T. musica* only has two life forms, OTE and OM which was an adaptive strategy to deal with the environment in which they are located. Thick encrusting form (OTE) in *T. musica* suggested due to they live in a strong current and high sedimentation habitat, so alteration of colony form became the solution to reduce fragmentation and other damage. Hubmann [15] give a clear explanation the adaptation pattern of coral *Manicina areolata* in Caribbean Sea which changes the colony morphology structure into the conical shape to reduce the current energy. *Pocillopora damicornis* has sub-massive branching coral, in a simple experiment: fragmented coral from this species was replaced in the mangrove area, turbid lagoon, reef back, reef flat, upper reef slope, and lower reef slope. And the result showed all fragmented coral have different life form. Habitat such as wave exposure, light absorption, sediment load, and currents be the main factor the life form formation [16].

Adaptation also found in *Acropora clathrata* that has a funnel shape in their growth form. According to Riegl [17] this growth form very effective for coral to remove in their colony surface with current speed about 50 m/s, so why *A. clathrata* had a good adaptation in high sedimentation condition. Coral morphology generally reflects environmental conditions, the adaptation usually through morphology plasticity.

Class frequency and health of *T. musica*

An ecologist today, using relative of surface area each colony per total surface area of all coral colony to state the coral reef ecosystem [13; 18]. Not such scleractinian coral that has complex variation in their colony morphology, stoloniferan only have two types of variation in their life form, massive and encrusting. In this study, the geometric formula approach (hemisphere) has been used to calculate the *T. musica* surface area according to Naumann [13]. It was clear stated in figure 3 the smallest class frequency of *T. musica* was a juvenile phase and it was common cycle in population biology at the tropical marine area. In tropical marine area, the benthic population will follow 6 stages: recruit, grow, maintain colony integrity, suffer partial mortality or die and disappear completely [19].

The high number of juvenile *T. musica* (figure 3) has many interpretations, **the first** high level of recruitment in this region, which also means water conditions on the island

is very conducive to a recruitment process. Florida reefs have lower coral recruitment than Curaçao due to high environmental stress and a lot of disturbances such as temperature, salinity, turbidity and nutrient enrichment [19]. **Second**, coral colony size is a relative object, a colony of coral consist may thousand polyps (individual) so that coral also called as modular organisms. Sometime a part of this modular suffer partial mortality and will decrease their size, from this some researcher concluded that size unrelated with the size of coral.

In this study, the colony *T. musica* was classification into health, broken 1, broken 2 and dead. These classifications were actual colony condition in the field area. Broken 1 and 2 is unhealth condition where colony of coral or octocorallia severe a syndrome or lesion. Weil [20] has been defined by the coral disease as any impairment of an organism's vital organ, system and/or body function. The effect of disease to the octocoral has been reported since 1982 in Caribbean, and outbreak of that disease impacted on mass mortality in octocoral [20]. And in the 1988 black band disease (BBD) was affected in *T. musica* and soft coral in the Red Sea, the cyanobacterium *Phormidium corallyticum* was suggested as causative agents [21].

Beeden [22] classified coral disease based on the morphotype of colony such as the existence of living tissue and deformation of colony structure. The classification of diseases tree regarded: Tissue loss (predation or non-predation), tissue discoloration (white and non-white), growth anomalies and compromised health (pigmentation, competition, sedimentation damage, eroder). Based on the definition of coral diseases already mentioned above, the disease can be caused by micro bacteria or due to mechanical lesions. In this study, no detailed observation in etiology of disease in colony *T. musica* that caused by micro bacteria, but more attention in other causalities, such as mechanical lesions or sedimentation.

Mechanical lesions might come from a various invertebrate, corallivorous fish, algal competitor and physical causes (wave, a current of anthropogenic, sediment). Bruckner and Bruckner [23] divided into 5 categories for biotic causes, they were: boring invertebrates, excavators, scrapers, browsers/grazers, and organisms that overgrow corals. A total about 190 types of corallivores made about 10 to 100s cm loss of coral tissue [23]. Physical trauma on coral and octocoral also can come from wave and anthropogenic activities [24]. Wave stress also responsible for a lot of coral fragmentation from scleractinian coral *Pocillopora meandrina* and *Porites compressa* in Hawaiian water. In wide scale impact of the wave to coral reef has been modeled in Great Barrier Reef [25].

CONCLUSIONS

In conclusions, the distribution of *T. musica* in Lirang Is. in generally dominant in the eastern area with significant number colony from the opposite area. Colony-size area of *T. musica* 's colony gives the characteristic tropical invertebrate population with dominant of the juvenile phase than an adult phase.

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