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Spatial Distribution of *Tripneustes gratilla* on Ambon Island

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ABSTRACT

Tripneustes gratilla has an important ecological role in various habitats because *T. gratilla* is directly or indirectly recycling key from the nutrients in the waters of Ambon Island. Ambon Island has a distinctive topography, thus causing inhibition of water exchange period naturally in Ambon Bay. In addition the increasing environmental pollution can narrow the habitat of *T. gratilla*. Therefore, this study aimed to determine the spatial distribution of sea urchins (*T. gratilla*) on Ambon. Distribution of *T. gratilla* population that found in Ambon Island generally has a relatively small number of individuals. From four locations that just only one location has large enough number of individuals. Therefore it is necessary to conserve *T. gratilla* on Ambon Island so that it won't extinct.

Keywords: *Spatial distribution, T. gratilla*

INTRODUCTION

Sea urchin usually found in areas with abundant algae [1, 2, 3, 4]. However some type of Echinoidea is a predator in coral reef communities [5, 6, 7]. Some Research showed that Sea urchin can be used as bioindicators for heavy metal contamination in water [8, 9].

Ambon Island located in eastern Indonesia have a high marine biodiversity index, one of them is *T. gratilla*. However exploration of *T. gratilla* in nature is expected to continue without considering aspects of sustainability, so there is a tendency Sea urchin population decreases dramatically [10]. Ambon Island have a unique topography, thus forming an ecological barrier [11, 12]. In addition, environmental contamination on the island of Ambon is increasing, especially in the bay than on the other area of Ambon Island [13].

With the ecological barrier and decreasing of environmental conditions, it is considered will complicate the interaction between individuals, thus triggering the occurrence inbreeding, high mortality, sterile, reduced mating ability, imbalance growth, the individual becomes susceptible to disease and environmental stress [14, 15]. The consequences could effect on competition ability of a species that can lead to loss function of the species and consequences for changes in an ecosystem [16]. Knowledge of the spatial distribution of *T. gratilla* allows understanding the patterns of connectivity and distance spread of *T. gratilla* on Ambon Island. This knowledge is an important factor to assess management strategies for *T. gratilla* long-term management conservation on Ambon Island.

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MATERIALS AND METHODS

Data sources

Species sampling, environmental data and mapping the distribution of *T. gratilla* conducted at the Ambon Island, Maluku, East Indonesia.

Mapping area

The map is processed with software QuantumGIS V1.8 subsequently is creating the raster map by the geo-referencing process in order to get the map in accordance with the original position. Following is to do the digitization map process by re-drawing the map with line shape, point, and polygons. Each layer is then given an appropriate name then overlayed to create a layout and then by providing symbols that describe the content of the map.

Data analysis

GPS coordinate data obtained from mapping *T. gratilla* in Ambon Island is transferred to Google Earth format files (*kml), subsequently reprocessed using QuantumGIS V1.8 software for determine the spatial distribution of *T. gratilla* on the Ambon Island.

RESULTS AND DISCUSSION

T. gratilla exploration at Ambon Island concentrated in the population at four different locations ie in the Suli village (S), Liang village (L), Poka village (P), and Hative Besar village (H). Poka village was located in inner Ambon Bay while Hative village located in outer Ambon Bay. Suli Village located in Baguala Bay while Liang Village located in the northern island of Ambon (Figure 1).

Temperature, salinity, dissolved oxygen, and pH waters in this study varied between study sites. *T. gratilla* habitat temperature recorded in this study between 23,3–26,2°C. The temperature is expected to support the growth of *T. gratilla*. This is because the temperature that is good for coral reefs, mangroves and seagrass that become *T. gratilla* habitat is between 28 – 30°C [17]. In addition a good temperature for growth of benthic animals was 25–30°C [18]. Salinity values in this study are not too varied and can support for the survival of benthic organisms such as *T. gratilla*. Recorded salinity ranged from 28-30$^{0/00}$, which also still in good conditions for *T. gratilla*, where the optimal salinity for sea grass and coral reefs are 30– 34$^{0/00}$ [17]. The pH waters in this study ranged from 8.1 to 8.5, while the dissolve

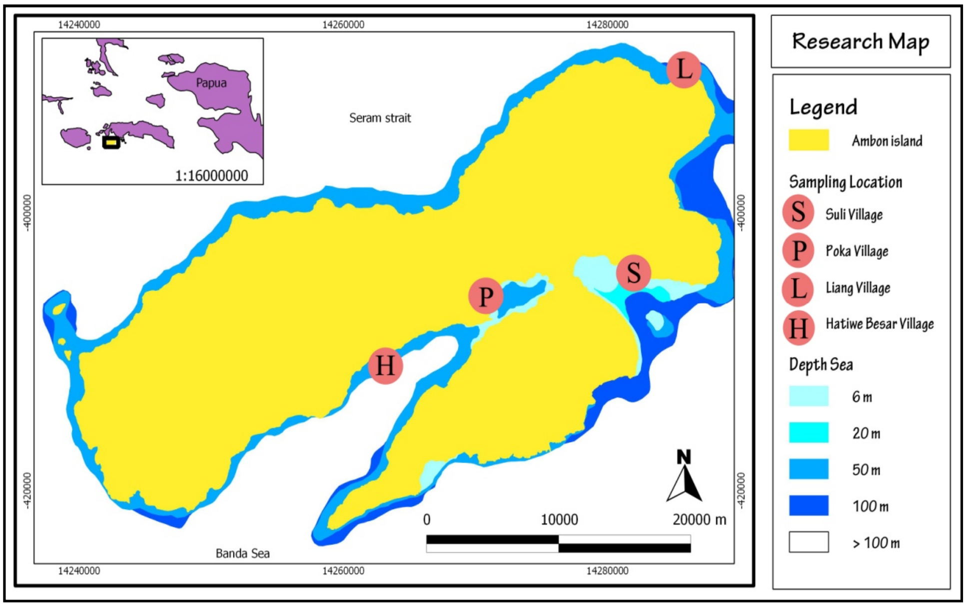

Figure1. Spatial distribution map of *T. gratilla* on Ambon Island

oxygen concentration in the range from 5.2 to 8.6 mg/L.

On the Hative besar population just found 2 individual *T. gratilla* (about 4,2 % from total *T. gratilla* found). This might be due to the condition of the waters in this location is not supportive for the growth of *T. gratilla*. The location close to the provincial capital is also expected to be the reason for the small population of *T. gratilla* in this place. Urban areas tend to experience rapid progress in terms of development. This makes often the erosion case and increased sedimentation, thus increasing the pollution. The increasing amount of pollution in the water will affect the organisms that live in these waters. Marine research in China noted that the pollutants contained in the water will greatly affect biodiversity, where for several years the number of species that live in the ocean will decrease even some species that can no longer be found [19]. Substrates found in the Hative Village bottom waters are a mixture of sand and coral. *T. gratilla* can live well in the area of seagrass, but seagrass was not found in this area (Figure 2a), while seagrass and algae have an important role for the growth of *T. gratilla* [20, 21]. Conditions of water temperature at this location did not have a significant variation, relatively similar in the range of 24,9°C. *T. gratilla* can live well at a temperature of 26 to 28°C [22], high temperature above 30°C can lead *T. gratilla* to die. The data showed salinity waters in Hative Village is at 28 0/00, with pH 8,1 and dissolved oxygen 5,9 mg/L.

Only 3 individuals *T. gratilla* found in the Poka Village population. Water conditions at this location in the range of 26, 2 °C. While salinity, pH, and DO consecutive $28^{0/00}$, 8,1 and 5,9 mg/L respectively. Comparison with the popula tion in Hative Village, Poka Village has a better substrate conditions in which still found seagrass beds, although the density is still low compared with Liang and Suli Village. Seabed at this location is dominated by a mixture of sand, algae, and seagrass beds, as well as the household waste from garbage dumped by humans. Despite having a sufficient better substrate for *T. gratilla*, the exploration results only found 3 individuals. Location of *T. gratilla* population that are too close to the port and waste from human, estimated to be the reason for the small populations of *T. gratilla* that exist in that location. Ship traffic which frequently operates can lead to pollutants such as oil spills into the sea (Figure 2b). This oil spill is predicted could damage the seagrass beds which will affect to *T. gratilla*. Research conducted by McCay et al (2004) explained the impact of oil spills on aquatic organisms. They noted that some species of fish and invertebrates can not survive in waters polluted by oil spill and experienced mortality [23]. In some cases mentioned that seagrasses will experience environmental stress if an increase of human activity in its habitat. Damage to the seagrass beds would direct effect on the abundance of *T. gratilla*, considering seagrass is an important factor in the growth of *T. gratilla* [24].

Populations of *T. gratilla* which located in Liang Village were larger than in the Hative and Poka Village. This difference is seen in the cover of substantial seagrass beds, so better to be a habitat for *T. gratilla* (Figure 2c). In this location the substrate is sandy habitat, consisting of coral reefs, algae and seagrass. Gibo et al (2012) reported the importance of interactions between coral reefs and *T. gratilla* in Hawaiian waters to keep the distributions between the two species [25]. Exploration results at this location found 10 individual *T. gratilla*. Location in the Liang Village is still minimal human activities. This situation makes the water conditions are still a way better with seagrass beds and coral reefs that are still well preserved.

Compared with the other three locations, Suli Village has a wider seagrass beds cover. Monk et al (1997) noted that the Suli Village is an area with an abundance of the highest seagrass beds on the Ambon Island, and Enhalus acoroides is the most dominant species [13]. At this location, seagrass abundance is directly proportional to the population of *T. gratilla*. *T. gratilla* found at this location is 32 individuals at 12 sites (Figure 2d). Suli Village located in the Baguala bay has a beach with a more ramps topography. This condition is very good for *T. gratilla* because this species usually live in shallow sea up to 75 m depth [26]. Seabed was in the form of sandy beaches and muddy sand which covered with seagrass and algae. The ups and downs that occur at this location is quite length when measured from the shoreline. Habitat *T. gratilla* at this location very well because it is supported by the calm waters and ramps as well as the availability of nutrients from healthy seagrass beds and coral reefs. Several researchers noted

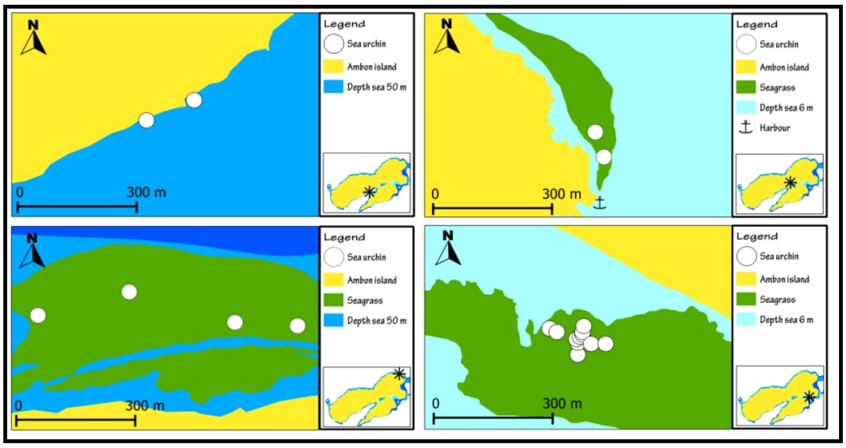

Figure 2. *T. gratilla* population: a) Hative besar Village; b) Poka Village; c) Liang Village; d) Suli Village

that there is a positive correlation between seaweed and seagrass with an abundance from *T. gratilla* in the waters [3, 24].

Habitat degradation and hydrological changes will cause a decrease in the population of species on intertidal areas like *T. gratilla* which will also have a negative impact on ecosystem [27]. Brennand et al (2010) reveal ecologically important of *T. gratilla*. *T. gratilla* is directly or indirectly recycling key from the nutrients in the sea [28].

There are four *T. gratilla* populations locations that can be found on Ambon Island. From the four locations, there are 2 locations that have relatively small individuals number. Those two locations are Poka Village (P) and Hative Besar Village (H) which located in the Ambon Bay. Small size of the population at risk of causing inbreeding occurs. Inbreeding may occur because the mating process between closely related individuals or have a closeness genetic [29]. In addition, the small population size could also be due to the influence of genetic drift. Genetic drift is a frequency change of gene variant (allele) in a population that could lead to the loss of gene variants [30]. Effect of Inbreeding and Genetic drift in small populations can lead to loss of genetic variability.

The loss of genetic variability due to Inbreeding and Genetic drift can increase the expression of recessive genes in a population so the individual becomes susceptible to disease [15, 31]. Moreover, the loss of genetic variability can result in decreased the adaptability of population from environmental changes [32]. This is because genetic variability is an important factor in evolution because it affects individual response to environmental stress [33]. Location is also an important aspect that needs attention because it will be habitat for *T. gratilla*. Based on the results of research is known that this species can survive well on minimal pollutants location and has a substrate consisting of coral reefs, algae, and seagrass beds. Therefore, strategic move that must be taken is fulfill the need for good quality habitat by ensuring the availability of coral reefs, algae, and seagrass beds so the conservation process can obtain maximum results.

CONCLUSIONS

Spatial distribution of *T. gratilla* on Ambon Island Sea was severely affected by habitat conditions. However, the main factor of *T. gratilla* survival is substrate available such as seagrass, algae, and coral reefs. The pressure from habitat destruction and environmental change can make benthic organisms such as *T. gratilla* on Ambon Island experiencing environmental stress that affects their survival.

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