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Monitoring of Corallivorous Fish's Bites on *Porites lobata* at South Java Sea, Indonesia

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Abstract

P. lobata is one of cosmopolite and abundance coral in south of Java sea. This coral will be found easier from reef flat to reef slope area. In ecological view, massive *P. lobata* has function as coastal protector from big wave and strong current also became "Pandora" for many invertebrate and fish that living inside and surround its colony. Predatory corallivorous fish to the massive coral Porites is a natural occurrence that function as coral growth control. This monitoring was conducted for 14 months to 4 massive *P. lobata* in reef flat area of Pantai Kondang Merak. Based on bites lesion was found on the surface of coral colonies that were three types of fish preyed to *P. lobata*, there were: triggerfish (Balistidae), butterflyfish (Chaetodontidae) and parrotfish (Scaridae). The total amount of fish bites was 4,315 for 14 months, which bites preferences in upper up (A) and middle up (T) were 77.7% and 22.3% at the bottom area (B) of coral colonies. Corallivorous fish bites will affect the possible spread of the disease and increase the potential death of coral colonies in the south of Java sea.

Keywords: Triggerfish, Butterflyfish, Parrotfish, Indian Ocean, Massive Coral

INTRODUCTION

South Java sea (8°23'48.73" S; 112°31'3.59" E) is directly adjacent with the Indian Ocean that has big waves and strong currents. This condition became main factor that only massive coral can growing well and dominate than other coral life form in this area. Poritiids and Faviids coral were found abundant in this area. Naturally, the existence of massive corals also threatens by other animals that feed on coral's skeleton. One of bio-eroder of coral reef is corallivorous fishes. There are about 128 species of corallivorous fishes from 11 different families there were Chaetodontidae, Labridae, Tetraodontidae, Monachantidae, Pomacentridae, Balistidae, Scaridae, Gobiidae, Blennidae, Ostraciidae and Pomacanthidae [1]. [2] said, there were three fish families that stated as corallivorous fishes: Chaetodontidae, Balistidae and Tetraodontidae. While Pomacentridae and Scaridae categorized as herbivorous fishes along with Acanthuridae and Siganidae. Last two fish families eat only 5% of living coral from their food, while the (butterfly fish, Chaetodontidae) prey more than 50% living coral. That's the main reason for this difference to classify the types of fish.

The next to ease the classification in this paper we divided corallivorous fishes into obligate and facultative corallivory. Known as obligates that they prey more 80% of live coral and facultative when slight prey of coral [3]. Butterflyfishes is true obligate because only eat live coral tissue and sometimes eat algae, sponges and worms (which live in coral) as food additives [4]. Corallivorous fishes almost prey in all of coral polyps, such as chevron butterflyfish (*Chaetodon trifascialis*) that often take tabulate Acropora (*Acropora cytherea*) [3], coral branching Pocillopora and massive Porites [5; 6], as well as coral Montastrea [7].

The effects of bites of fish on coral colonies usually left scars or wound. Some corallivorous fish proved only takes a polyp (polyp feeder) that no tissue damage corals, but some them made a very deep bite, causing damage to the tissue of the coral. Humphead parrotfish (*Bolbometopon muricatum*) can eat the tissue of coral up to 15 kg per m^2 in one year [8]. If the scars that caused by bites of fish not recover quickly, it will result in partial death of coral colonies [6]. The combination of environmental stress and the fish bite will affect on permanent death of the coral colonies. The result of fish bite also effects on coral health. Black Band Disease (BBD) was an infectious coral that caused by bacterial consortium that transmission from diseased coral colonies to the health coral by *Chaetodon capistratus* [9]. More activities on coral predation on coral colonies will result in decreased of percent coral cover in certain region.

Massive coral *P. lobata* is one of of main built of coral reef in Indo-Pacific region which can be found from 1-20 m depth [10]. Coral Porites in south Java sea not only in massive form but also form a micro atoll that to be host or substrate to other hard corals such as *Acropora* sp, *Goniastrea* sp, *Favia* sp and *Pocillopora damicornis* [11]. The massive *P. lobata* mostly has wide on its diameter so can easily be expanded by another invertebrate. Macro borers from bivalve (*Lithopaga laevigata*), the vermentid (*Dendropoma maximum*) and sepulid polychaeta (*Spirobranchus* sp) [12] were live in Porites coral's tissue. More than 24 species of reef fish have been eating of coral Porites, as well as various diseases can be found on this coral, such as, black band disease (BBD) that caused by fungi [13], Porites ulcerative white spot (PUWs) [14], growth anomalies [15] also competition with algae [16].

Observation of fish bite on a coral *P. lobata* which were dominant in south of Java sea was important as bio indicator of damage coral reefs in this area. The greater threat to corals actually is came from the human activities such as the used of cyanide to fishing lobster, many tourist activities effect on trampling of coral to be small fragment, the influx of nutrients and sediments from the terrestrial due to the substitution of perennials with seasonal plants and up take coral skeleton to house foundation. The aims of this study were to determine the number of fish bite on coral *P. lobata* and to determine the prevalence of fish bite on *P. lobata* that predicted will affect on coral reef health in south Java sea.

MATERIAL AND METHODS

Study site. We observed the fish bite for 14 months (April 2014 - May 2015) on 4 colonies of *P. lobata* in reef flat area of Pantai Kondang Merak, South of Malang, East Java, Indonesia ($8^0$23'48.73" S, $112^0$31'3.59" E). We took 4 stations to monitor fish bites scared on surface of massive *P. lobata* colonies. Station B1 and B2 were representative of west part area and T1 and T2 were representative of east part area (Figure 1).

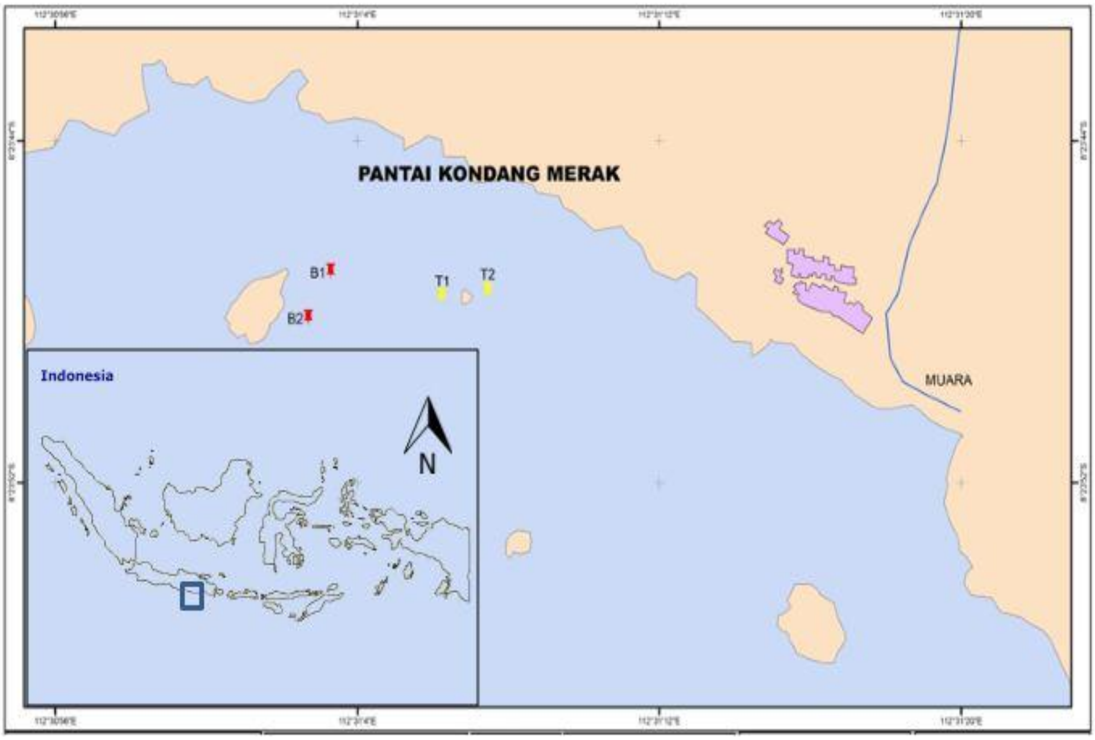


Figure 1. Maps of study site, in South of Java Sea (Pantai Kondang Merak), Indonesia

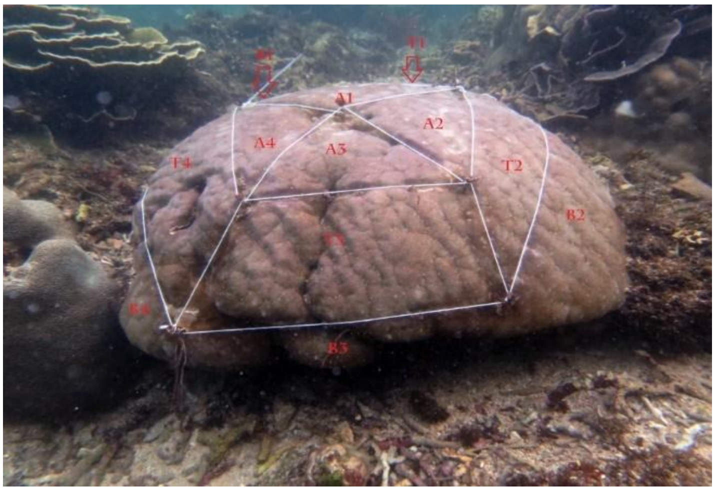


Figure 2. *P. lobata* in station B1, fish bites mark each sub-plot were photograph and then analyzed in laboratory. **Photo** by Siagian.

Fish bites data. We choose one colony each research station with 1-2 m in diameter. Each colony was divided into three plots, the upper part (A), middle part (T) and bottom part (B), on each plot was divided into 4 sub-plots, total was 12 sub-plots in each colony of *P. lobata*. Then We recorded all various bites mark in each sub-plot using underwater camera, Canon Powershoot G 16 (Japan) and classified them as new bytes, old bites and recovery. Bites lesion then identified and calculated using Image J (NIH, USA), to make sure the lesion we checked exposed skeleton bar using guidance of [17].

Prevalence of fish bites. We used fish bites prevalence using formula that issued from [17] as below:

$P = \frac{a}{A} x100$.. Formula (1)

Where are:

P= Prevalence of fish bite (%)

a= bite from certain fish

A= total bites in a colony

RESULT

Fish bites. The total number of fish bites were 4,315 for 14 months or 25.7 bites/ month. The highest coral bite was in November 2014, with 409 new bites. The most bites were found on upper part (A) area (1,441 bites), second one on middle part (T) area (1,913 bites) and the fewest on the bottom part (B) area (961) (figure 3). In July to August 2014 were not found even fish bite on the coral *P. lobata*, their surface colony recovery completely from last month bites. We cannot reach data in December 2014 to March

2015 due to bad weather (south-west monsoon), high precipitation load sediment from terrestrial and effect on water clarity. During April to May 2015 the number of bites increased sharply to 1350 on all corals. Total fish bites on the upper up (A) and middle up (T) were 77.7% and 22.3% at the bottom area (B) of coral colonies.

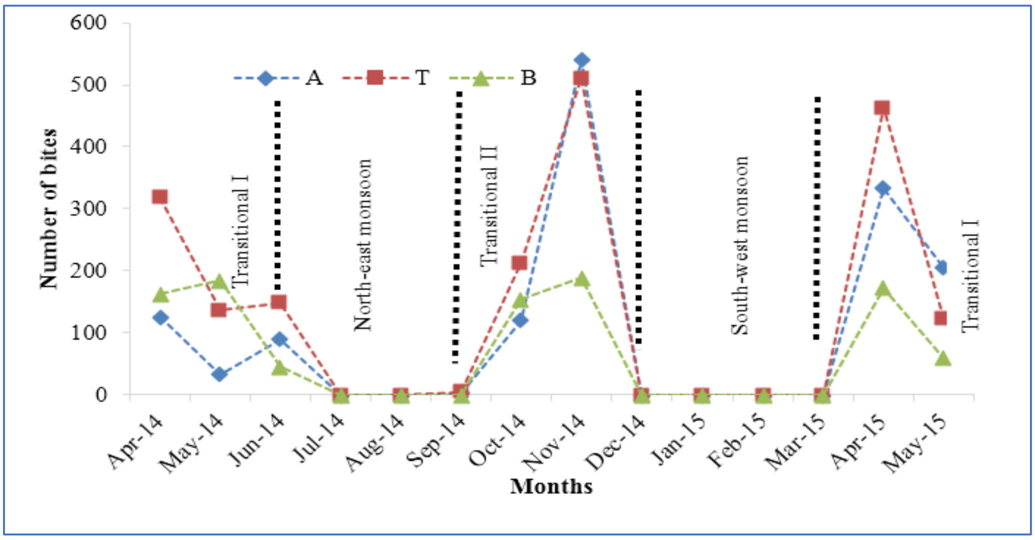


Figure 3. Number of bites every month in *P. lobata* by all corallivorous fish

Corallivoruous Fishes and fish bites prevalence. According fish scare was found in the surface of *P. lobata* there were three species of fish that had preyed on it, i.e. triggerfish (Balistidae), butterflyfish (Chaetodontidae) and parrotfish (Scaridae). Triggerfish is the most prayed on *P. lobata* by 68.1%, butterflyfish was 28.1% and parrotfish was 3.8% (figure 4).

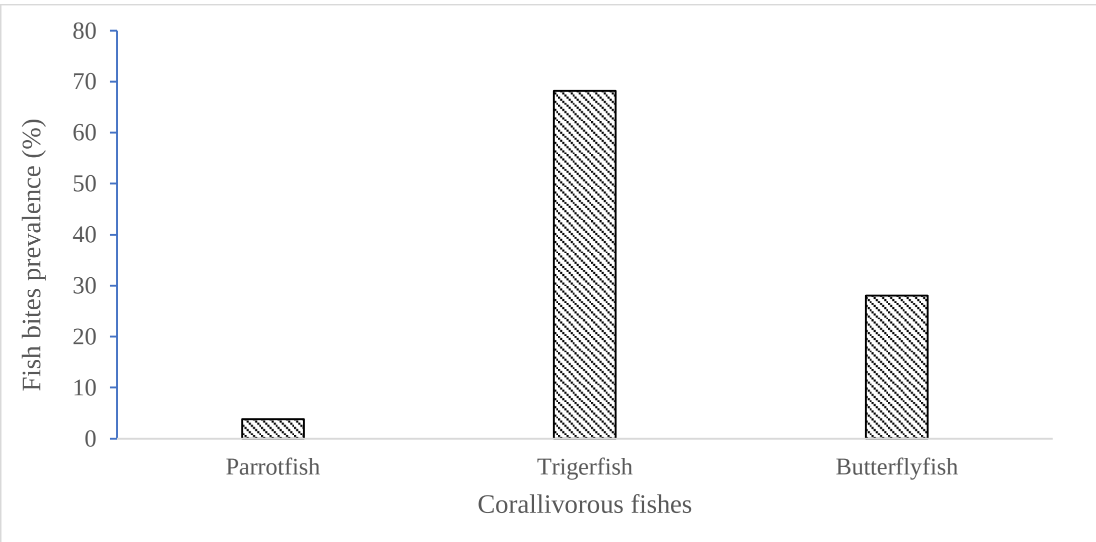
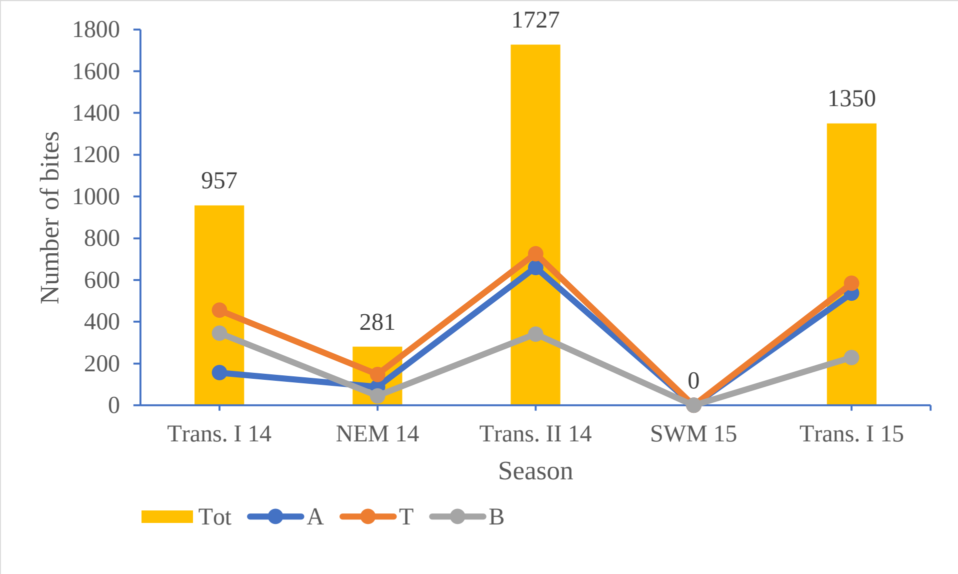


Figure 4. Corallivorous fish bites prevalence to all coral colonies

Seasonal fluctuations. In general, Indian Ocean which was on the southern part of Indonesia influenced by local seasons in Indonesia, there were south-west monsoon (December, January and February), the first transitional (March, April and May), north-east monsoon (June, July, and August) and the second transitional (September, October and November) (figure 5). Figure 5 showed that 1,727 fish bites during the second transitional and 281 bites on north-east monsoon.



Annotation. Trans. I 14= transitional season I 2014; NEM 14=North-east monsoon 2014; Trans. II 14= transitional season II 2014; SWM 15= South-west monsoon 2015; Trans. I 15= transitional season I 2015.

Figure 5. Seasonal fluctuation of corallivorous bites

DISCUSSION

Fish bite. Overall corallivorous fish prefer to prey the upper up (A) and the middle up (T) position than at the bottom (B), the number of zooxanthellae expected to be one important factor. The number of the zooxanthellae that living in upper and middle colony *P. lobata* was estimated more than at the bottom because these positions higher received the light intensity so zooxanthellae faster to do proliferation. While at the bottom often interact with high sediment, algae and echinoid which will reduce the number of zooxanthellae in the coral tissue. [18] proved that bleaching of *Acropora nobilis* had less predation by corallivorous fish due to less of zooxanthellae and changed of biochemical coral tissue.

Fish bites prevalence. Triggerfish prey many types of food: corals, algae, gastropods, sponges and sand dollars [19; 20]. While butterflyfish feed living coral in three ways, first just eating coral polyps (polyp picker); second, prey mucus of coral (mucus slurpers); third, prey coral polyps and skeleton (lunger); fourth, prey about 16-50 coral polyps in the same time (scraper) and fifth, prey about 3-10 coral polyps in the same time (scraper) [21]. We only found 1 species parrotfish in this study, *Scarus frenatus*, it was 5 species commonly prey on live coral in the Indo-Pacific, they were *Bolbometopon muricatum* (prey polyp coral 13.5 kg/ m^2/ year), *Cetoscarus bicolor, S. frenatus, S. gibbus* and *S. rivulatus* [21].

Triggerfish mostly prayed on upper and middle area of coral colony (A = 41.9%; T = 48.2% and B = 9.9%), while butterflyfish preferred to prey on the middle of coral (A = 52.7%; T = 33.8% and B = 13.5.9%) and parrotfish prayed on upper area (A = 52.2%; T = 39.1% and B = 8.7%). Triggerfish prefers eating coral polyps on upper and middle part because the possibility of a lot of boring and infauna live in this segment. Butterflyfish also choose the upper and middle part, may they had carried habit to prey polyp of Acropora and Pocillopora only in the upper and middle branching and this practice was also carried out on the coral massive *P. lobata*. Parrotfish prefer to prey the algae which was located in the middle part of the plot (T), probably that were many algae attached in this part and naturally parrotfish prey always on schooling, may be the middle or upper part has spacious spaces depend on bottom part. *P. lobata* the most susceptible preyed by corallivorous fish due to several factors: first, because its lifeform massive and large colony. Second, *P. lobata* has smaller nematocysts than other coral like *P. damicornis*, *P. meandrina* and *Porites compressa*. Corallivorous fish obligate prefer to prey on corals that have small nematocysts to reduce stung from coral [22].

Seasonal fluctuations. During in south-west monsoon we did not noted any data because bad weather condition and heavy rain that brought sediment from terrestrial and make bad visibility in the sea water. During monsoon both north-east and south-west monsoon Indian-Ocean has strong current that influenced the existing of south java current about 0.8-1 m/s in average [23]. The result from strong current usually stirred sea bed sediment causing high suspended sediment in water column. During this time, some corallivorous fish will migrate to deeper area (reef slope), hiding in cars cave and prey coral that living in this depth. During north-east monsoon, Kelvin upwelling will be occurred in Indian-ocean area, and brought a lot of nutrients from the deep sea into the sea surface [23; 24]. It was suggested that corallivorous fish and coral in surrounding of cave obtained enough nutrients during turbid waters. *P. lobata* is a cosmopolite coral that can survive in high sediment condition. Massive life form (boulder like) make sediment ease down into substrate in some case *P. lobata* has ability to cover its colony using mucus which prevents the sediments fall into coral polyps [25; 26].

During lag time, *P. lobata* will use this time to heal the wound by restoring its tissue through asexual reproduction (growth) [27]. The tissue regeneration speed also influenced by type of bite (lesion) effect of corallivorous bites. Lesions caused by fish Chaetodontidae easier recovery than the lesions caused by parrotfish. Lesions caused by bites of fish Chaetodontidae not very deep and broad like parrotfish bites. Wider of lesion it takes longer time and lot of energy has been spent by coral to heal it. The lesions are located on the upper up of the colony have faster healing process compared with in bottom, it was caused by will also experience faster wound healing compared to wounds located at the bottom, because the bottom of the colony lack of sunlight, nutrients and interacts with the sediment that slows down the process of recovery [28]. In cellular view, healing process in Porites started by multiplication of melanin that contain granular cell and by 48-hour cell will produce amoebocytes and fibroblast to heal the wound (lesion) [29].

CONCLUSION

The total number of new bites from corallivorous fish in *P. lobata* in south Java sea during 14 months, was 4,315 with a prevalence of triggerfish 68.1%, butterflyfish was 28.1% and parrotfish was 3.8%.

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