

# Spiny lobsters species composition between North and South Sea of East Java, Indonesia

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(Received 27 September, 2019; Accepted 10 January, 2020)

## ABSTRACT

Indonesia is the largest archipelagic state with very complex oceanography. The biogeography of the state is really diverse. Information of the distribution of marine organisms is necessary for their management. The management of Indonesian fisheries resources has been set into 11 State Republic of Indonesia fisheries management areas (WPPNRI). East Java Province is in 2 management areas, namely WPPNRI 712 in the North (Java Sea) and WPPNRI 573 in the South (Indian Ocean). One of the priority resource groups in management is lobster fisheries. Lobster is known as a fishery commodity with very high economic and ecological value. This study aims to identify dominant lobster species of East Java which will be used as study indicator for management of the lobster fisheries. Data collection was carried out in the largest lobster collectors and distributors in East Java. Data analysis was performed using Chi Square and ANOVA (Analyses of Variance). Dominant lobster species in the North Sea are *Panulirus polyphagus* (Udang Pakistan) and *P. ornatus* (U. Mutiara) while the South Sea is *P. homarus* (U. Pasir) and *P. penicillatus* (U. Batu).

**Key words:** *Composition, Distribution, East Java, Fisheries management, Indian ocean, Indonesia, Java sea, Lobster.*

## Introduction

Connectivity in fisheries management (marine spatial planning) is necessary. Connectivity is a flow of organisms, matter, and energy across a landscape (Lipcius *et al.*, 2008, Kough *et al.* 2013). One goal in the fisheries management is a connected conservation or reserve areas to support sustainable fisheries management. Reserve design and spatial planning of marine realm in regions where endangered and

endemic (panulirus lobster/spiny lobster) species are prevalent has largely occurred without fully understanding the distribution or migration behavior of the species. As a result, existing establishment of marine reserves often prevent or undermining migration (Whomersley *et al.*, 2018). Reserve design generally focuses on protecting the habitat within the range of known appearance of target species. Furthermore, species dispersal of the lobster is poorly understood, effectiveness reserve is still not

guaranteed even when conservation criteria to protect critical and endangered species such as lobster and turtles are met. Study of species dispersal is focused on how lobsters' species distributed across the temporal and spatial scale. The study discusses how the distribution of lobster species may improve reserve design for protecting crustaceans such as spiny lobster (*Panulirus spp.*).

The Indonesia archipelagic state are historically influenced by the Pacific and Indian Ocean and developed by two ancient landmasses that is Laurasia and Gondwanaland (Brown and Lomolino, 1998). The inhabitant of those water and landscape are accumulated and formed an ecosystem of the state with a high diversity as well as a complexity. The place is known as a centre of refuge, centre of overlap, and centre of origin. It is also labeled as Indo-Australia Archipelago (I-AA) and Center of Indo-Pacific (CI-P) (Janet Sprintall *et al.*, 1999; Carpenter and Springer, 2005; Allen and Erdmann, 2012). Within those jargon, diversity, endemism and evolutionary important of the state marine organisms is among the consideration criteria used for designing management and conservation (Barber *et al.*, 2011; Radford *et al.*, 2011). Tropical lobster and Eastern Indian Ocean (the Marine Eco-region of the World/MEOW) has been in consideration lists (Keesing and Irvine, 2005; Spalding *et al.*, 2007).

As a part of the Eastern Indian Ocean, The South Sea of East Java has been inhabited by six lobsters species of a group of *Panulirus* (e.g. *Panulirus ornatus* (Udang mutiara), *P. homarus* (U. pasir), *P. penicillatus* (U. batu), *P. versicolor* (U. bambu), *P. longipes* (U. batik) and *P. polyphagus* (U. pakistan)) (Setyanto *et al.*, 2019). Lobsters have an ecological, economical as well as social important of the nation. Comparative lobster's species richness among biogeography of East Java provides powerful tool for fisheries and marine resource managers.

Sustaining utilization of lobster resources through effective management and conservation is a challenge for the management authority. Scientific information on species distribution is necessary not only for the management and conservation but also for marine culture development of the lobster. Since the information is rare the study is going to examine the distribution pattern of lobster in a certain spatial system to develop formulations to protect and conserve the lobster from collapsing. The present study analyzes species composition of lobster between North and South Sea of East Java, Indonesia.

## Materials and Methods

### Time and Research Location

The data was collected mainly from two locations i.e. North Sea of East Java lies in Java Sea (represented by Tuban, Lamongan, Bawean, Madura archipelago) and Trenggalek of the South Sea of East Java in Indian Ocean (Fig. 1). Data collection were carried out in December 2016, January to March 2017 from Lamongan while from Trenggalek were collected from February to June 2018.

### Data Collection Method

Data was collected from lobster collectors in East Java. Each species found was sampled and identified directly at the sampling location. Species identification refers to the book of *Marine lobsters of the world* (Holthuis, 1991) and *FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Volume 2* (Carpenter and Niem 1998.). The lobsters are then calculated by the number of individuals per species in each location.

### Data Analysis

The collected data was then analyzed using the Chi-square frequency analysis to looking at the species composition between North and South sea of East Java. The chi-square analysis was calculated using MS\_Excel. Analysis of Variance (ANOVA) method performed with the SPSS (Statistics Programs for Social Science) software application to find out the dominant species of the North and South Sea of East Java.

## Results and Discussion

Species composition of North Java lobster is *P. polyphagus*, *P. ornatus*, *P. versicolor*, and *P. homarus* while the South Java is *P. homarus*, *P. penicillatus*, *P. versicolor*, *P. ornatus*, and *P. longipes* (Fig. 2). Species absent from the North is *P. penicillatus* and *P. longipes* while from the South is *P. polyphagus*. Species composition of North and South Sea of Java is different by significance test of Pearson chi-square is 0.586 ( $p \geq 0.001$ ). It could be said that the proportion of lobster species for both regions are the different.

Once the chi-square reject the  $H_0$  the analysis then followed by the test that try to address the difference of the species composition by Java Sea Region (North vs. South). The difference of the compo-

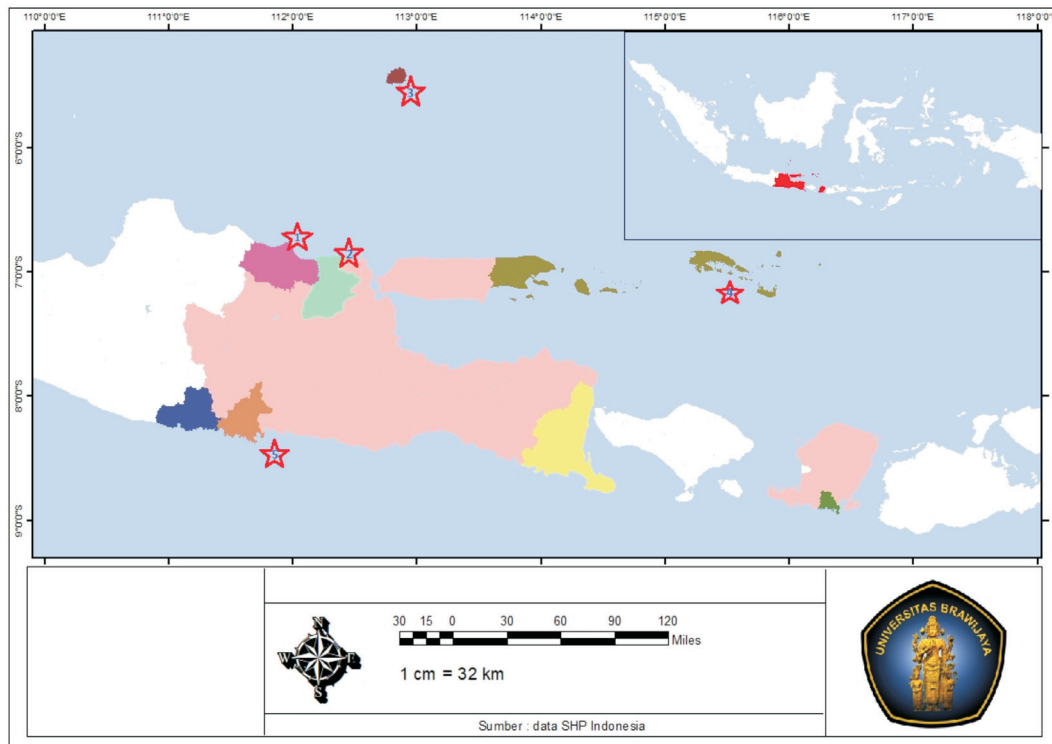


Fig. 1. Location of study (red stars) 1: Tuban, 2: Lamongan, 3: Bawean, 4: Madura, and 5: Trenggalek.

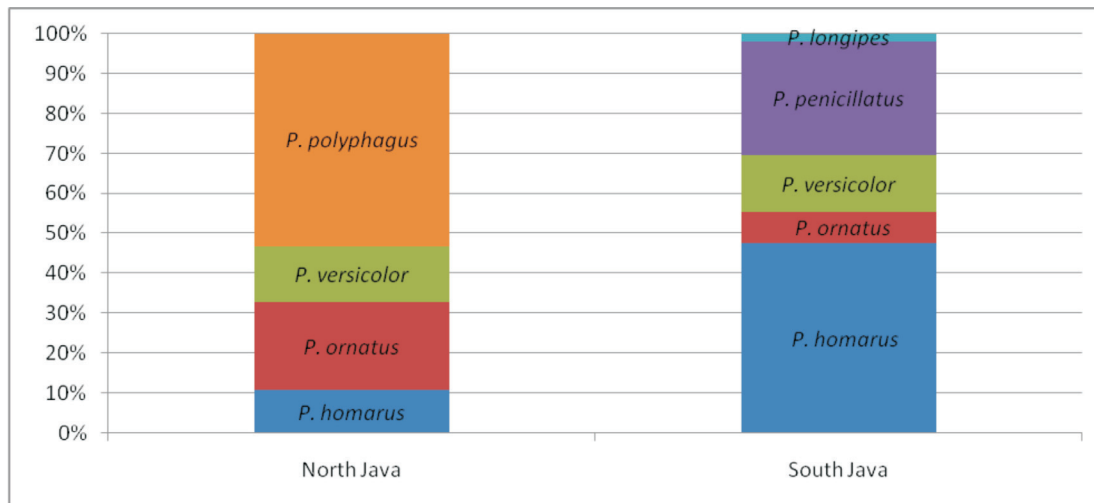


Fig. 2. Proportion of lobster species between North and South Sea of Java.

sition/proportion of lobster species between North and South were analyzed and tested statistically using Analysis of Variance (ANOVA)/F test. The ANOVA test will be followed by Tukey/Fisher test to show which species are differ between one and another within each region. The ANOVA test shows that the species composition is different in the North

as well as in the South by ( $F_{(5,960)}=97.640, p<0.001$ ) and ( $F_{(4,25)}=10.225, p<0.001$ ) respectively. It is suggested that the dominance composition from the North is *P. polyphagus* followed by *P. ornatus*, *P. versicolor*, and *P. homarus*. The least dominance is *P. penicillatus* and *P. longipes* (Table 1). Meanwhile the South dominant species is *P. homarus* and *P.*

**Table 1.** Subset/Tukey test table of lobster species of North Java.

| Species                          | N   | Subset |      |      |       |
|----------------------------------|-----|--------|------|------|-------|
|                                  |     | 1      | 2    | 3    | 4     |
| Batik ( <i>P.longipes</i> )      | 160 | .00    |      |      |       |
| Batu ( <i>P. penicillatus</i> )  | 160 | .00    |      |      |       |
| Pasir ( <i>P. homarus</i> )      | 160 |        | 2.41 |      |       |
| Bambu ( <i>P. versicolor</i> )   | 160 |        | 3.10 | 3.10 |       |
| Mutiara ( <i>P.ornatus</i> )     | 160 |        |      | 4.85 |       |
| Pakistan ( <i>P.polyphagus</i> ) | 160 |        |      |      | 11.76 |
| Sig.                             |     | 1.000  | .882 | .059 | 1.000 |

**Table 2.** Subset/Tukey test table of lobster species of South Java.

| Species                         | N   | Subset |        |        |
|---------------------------------|-----|--------|--------|--------|
|                                 |     | 1      | 2      | 3      |
| Batik ( <i>P.longipes</i> )     | 160 | 1.600  |        |        |
| Mutiara ( <i>P.ornatus</i> )    | 160 | 6.600  | 6.600  |        |
| Batu ( <i>P. penicillatus</i> ) | 160 |        | 24.200 | 24.200 |
| Bambu ( <i>P. versicolor</i> )  | 160 | 12.000 | 12.000 |        |
| Pasir ( <i>P. homarus</i> )     | 160 |        |        | 40.200 |
| Sig.                            |     | .564   | .115   | .175   |

*penicillatus* followed by *P. versicolor*, *P. ornatus* and *P.longipes* (Table 2).

The existence of those six species of spiny lobster across the Indonesia archipelago had been believed as result of tectonic plate movement (George, 1997, Klomp maker *et al.*, 2014). The appearance of those species has been supported by some previous studies conducted along the Indian Ocean (Soemarno *et al.*, 2019). The occurrence of *P. polyphagus* in the North Sea of East Java was found more frequent compare to other species. It is likely that they inhabit the North Sea. While the dominant species found in the South Sea of East Java was *P. homarus* and *P. penicillatus*. The founding of the present study are in accordance to the previous study stated that Indian Ocean is the habitat of *P. homarus* and *P. penicillatus* (Abdullah, Alimuddin *et al.*, 2014; Farhadi *et al.*, 2017). Despite of the length of the lobster's larval period, oceanographic current system (e.g. North Java current of the Java Sea and Equatorial current and South Java current in the South Java of Indian Ocean are likely to create barrier and impact routes and directions of larval dispersal of lobsters' species across the biogeography of East Java.

## Conclusion

Based on the present study, the management of lob-

ster fisheries between North and South Sea of East Java province should have difference species indicator. The North and the South should refer to *P. polyphagus* and *P. homarus* respectively. The study revealed that there a discrete lobster species domination between the two areas. On the basis of this evidence, lobster fisheries management on each of these areas should be managed separately. The discrete stocks lobster species of these areas are also potential for aquaculture development of those species. Moreover, the importance of conservation of the existing species within those areas are emphasized (Yellapu 2015; Yellapu *et al.*, 2016). More extensive sampling and genetics analyses are warranted to confirm this presented study.

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