Species composition of puerulus spiny lobsters from the South Sea of Banyuwangi, East Java, Indonesia

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Abstract. Species diversity is prevalent throughout Indonesia’s Coral Triangle areas. A fisheries management area has been set over its archipelagic waters ensuring the sustainability of the resources. Six species spiny lobster of Panulirus are known to live in Indonesia archipelagic waters. They have a significant contribution to the country. A study on the distribution variation of the marine organisms through the life phase in space and time is critical information for its management. Therefore, a similar study was conducted for the lobster population along the South Sea of Java of Eastern Indian Ocean. The purpose of this activity was to develop formulations to protect ecosystems and conserve lobster resources. Distribution of pueruli larvae of spiny lobster of Panulirus species was surveyed in Banyuwangi, East Java from February to March 2019. The number of pueruli larvae caught were counted and compared among the species. Data analysis was executed using the ANOVA test. There were four species of lobsters found. Dominant species were Panulirus homarus (Scalloped spiny lobster), P. pennicillatus (Pronghorn spiny lobster), P. versicolor (Painted spiny lobster) and P. ornatus (Ornate spiny lobster). Life history distribution of the species may support connectivity hypotheses of the lobster population in the region.

1. Introduction
South Sea of Java is among 232 eco-regions proposed in the Marine Eco-regions of the World (MEOW). The transition areas of Java include the South Sea of Java, South Nusa Tenggara Sea, Sawu Sea, and West of Timor Sea [1]. The South Java Sea stretches from the Ujung Kulon peninsula (Pandeglang, Banten Province) to the west up to the Blambangan peninsula (Banyuwangi, East Java Province) in the east.

Six species of spiny lobsters inhabit the South Sea of Java. They are Panulirus ornatus (Udang mutiara), P. homarus (Scalloped spiny lobster), P. pennicillatus (Pronghorn spiny lobster), P. versicolor (Painted spiny lobster), P. longipes (U. batik) and P. polyphagus (U. pakistan) [2]. The decapods have pelagic and diffuse larval phases, which then end in the settlement in suitable coastal habitats. The lobster's larval life cycle begins with the planktonic (phyllosoma) larval phase to the next stage into
the nekton post-larvae (puerulus) phase. The puerulus moves towards the coast to settle in shallow coastal waters then become small lobsters (juvenile) that are benthic and settled [3].

The site and stimulus of metamorphosis from phyllosoma to the puerulus phase has been undecided. At the end of phyllosoma phase, the larvae metamorphosed into puerulus which is likely to involve a swimming ability and passive processes such as surface currents [4]. The distribution of puerulus in some offshore surveys indicates that their movement is towards the coast compared to movements that spread randomly. It was suggested that the puerulus phase and the final phase of the phyllosoma are able to move towards the shore or shallow waters from the offshore waters more than 50 km. This movement is the period in which the settlement process takes place. This period is very important on the stock of the local lobster population which indirectly affects the local lobster catch [5, 6].

It is likely that larval dispersal is very essential for the management and conservation of fisheries resources, including lobster. However, life history-based study for lobster fisheries management advice to protect and preserve lobster resources is limited. So the purpose of this activity is to develop formulations to protect ecosystems and conserve lobster resources. The preliminary study that needs to be done is to examine the pattern of distribution of lobster larvae in each species in space and time.

2. Research methods
2.1. Time and Research Location
The data was collected from the Lampon Beach, South Sea of Banyuwangi, East Java (Figure 1). Data collections were carried out from February to March 2019. Geographical coordinate of the location was 8.616973° South latitude and 114.087391° East longitude.

![Figure 1. Study location (red circle), Lampon beach, Banyuwangi of east java.](image)

2.2. Data Collection Method
Data were collected from lobster larvae fishers. Each species found was sampled and identified directly at the sampling location. The lobsters were then calculated by the number of individuals per species.
2.3. Data Analysis
The data was then analyzed using the Analysis of Variance (ANOVA) method with the MS_Excel and SPSS (Statistics Programs for Social Science) software application. Excel was performed to produced graphical data while SPSS for statistical analysis.

3. Result and Discussion
Four species of lobster larvae were found in research location, i.e.: *Panulirus ornatus* (Ornate spine lobster), *P. homarus* (Scalloped spiny lobster), *P. penicillatus* (Pronghorn spiny lobster), and *P. versicolor* (Painted spiny lobster). Another two species i.e., *P. longipes* (Longlegged spiny lobster) and *P. polyphagus* (Mud spiny lobster), were absent. The description of the species composition is shown in Figure 2. *P. homarus* (Scalloped spiny lobster) was likely the most species inhabit the South Sea of Banyuwangi.

![Figure 2](image)

**Figure 2.** Larval spiny lobster species proportion from Lampon Beach, Banyuwangi.

The ANOVA test then was executed to derive statistical acuity. It is found that the species composition was significantly different ($F_{(3,196)} = 442.289, P<0.001$) (Table 1). *P. homarus* (Scalloped spiny lobster) was the dominant species followed by *P. penicillatus* (Pronghorn spiny lobster), *P. versicolor* (Painted spiny lobster) and *P. ornatus* (Ornate spiny lobster) (Figure 3). Evolutionary history of biogeography province revealed that the Indian Ocean was dominated by *P. homarus* compared to other lobsters’ species across Indo-Pacific region [7]. The other two species (*P. longipes* and *P. polyphagus*) were not found during the study. It was likely because they inhabit different habitat than the four species found in this study. They may dwell in different types of substrate bottom, depth and season.

| Table 1. ANOVA test of between-species effects. |
|---|---|---|---|---|---|
| Source | Sum of Squares | df | Mean Square | $F$ | Sig. |
| Contrast | 119118.280 | 3 | 39706.093 | 442.289 | .000 |
| Error | 17595.720 | 196 | 89.774 | | |
South sea of Java is influenced by the major current in the Indian Ocean, which is Equatorial Counter Current, South Java Current, and South Equatorial Current. It is also impacted by major current from other ocean generated through Indonesian Through Flow (ITF) such as the South China Sea, Java Sea, Sulawesi Sea and Banda Sea [8,9,10,11,12]. The connected current from different sea regions may support the biodiversity of marine fauna including spiny lobsters along the South Sea of Java. Based on these findings as well as anecdotal observations, it was suggested that lobster larvae populations in this system were controlled by physical factors, especially species inhabit sea floor.

Despite six species of spiny lobsters have been found along the South Sea of Java, there were only four species found in Banyuwangi waters. They were: *Panulirus ornatus* (Udang mutiara), *P. homarus* (Scalloped spiny lobster), *P. penicillatus* (Pronghorn spiny lobster), and *P. versicolor* (Painted spiny lobster). The most common species was *P. homarus* (Scalloped spiny lobster). It was likely that the species compositions of lobster larvae are patchy between the spatial spheres. Within East Java province alone, the species compositions among regencies along the southern coast are possibly to be different. Nevertheless, the dominant species was expected to be *P. homarus* (Scalloped spiny lobster).

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