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

A Setyanto1,2,3*, W A Saputra4, Soemarno2, DGR Wiadnya1 and C Prayogo2

1Faculty of Fisheries and Marine Science, Universitas Brawijaya, Malang-Indonesia
2School of Postgraduate, Faculty of Agriculture, Universitas Brawijaya, Malang-Indonesia
3Coastal Resilience and Climate Change Adaptation (CORECT) Research Group, Faculty of Fisheries and Marine Science, Universitas Brawijaya, Malang-Indonesia

*Corresponding author: a.setyanto@ub.ac.id

There are about six species of tropical spiny lobsters within a group of Panulirus inhabit Indonesia archipelagic waters. A lobster fishery is among relevant national fisheries products. Their social, economic, and ecological contributions to the country are significant. Hence, the lobster's resource sustainable use always becomes a challenge for the management authority. Life phase distribution of marine organisms in space and time is critical information for management. The equivalent study can be phrased for the lobster population in the South Sea of Java Island of Eastern Indian Ocean. The purpose of this study was to develop formulations to protect ecosystems and conserve lobster resources. Distribution of pueruli larvae of spiny lobster of Panulirus species was surveyed in the South Sea of Pacitan, East Java from January to February 2019. The number of pueruli larvae caught were counted and compared among the species. An ANOVA test was performed for data analysis. There were four species of lobster found. The dominant species was Panulirus homarus (Scalloped spiny lobster). It was followed by P. versicolor (Painted spiny lobster), and P. ornatus (Ornate spiny lobster). The least dominant was P. penicillatus (Pronghorn spiny lobster). Comparative study on life stage distribution concerning to larval dispersal may support the connectivity hypotheses of the lobster population in the region.

1. Introduction

Eastern Indian Ocean, including the South Sea of Java, is one of the 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 coastal waters stretch from the Ujung Kulon peninsula (Pandeglang, Banten) in the west up to the Blambangan peninsula (Banyuwangi, East Java) in the east of Java.

There were six species of lobsters live in the South Sea of Java particularly in the Eastern Indian Ocean of East Java. They are in a group of Panulirus, i.e: Panulirusornatus (Ornate spiny lobster), P. homarus (Scalloped spiny lobster), P. penicillatus (Pronghorn spiny lobster), P. versicolor (Painted spiny lobster), P. longipes (Longlegged spiny lobster) and P. polyphagus (Mud spiny lobster) [2]. Most fish species and coastal decapods have pelagic and diffuse larval phases which then end in settlement in suitable coastal habitats. The lobster's larval life cycle begins with the planktonic (phyllosoma) larval phase. The next stage, it changes into the nekton post-larvae (puerulus) phase that
swims towards the coast to settle. Afterward, they inhabit shallow coastal waters until they grow to become small lobsters (juvenile) [3].

Habitat factors triggering changes from phyllosoma to the puerulus life phase are remain unclear. Survival of the metamorphosed puerulus from phyllosoma depend on a swimming ability and passive processes such as surface currents [4]. The movement of puerulus towards the shore or shallow waters from the offshore waters is more than 50 km. This period is known to be a settlement process and is very influential on the stock of the local lobster population. A successful settlement will indirectly have an impact on the catch of local lobster [5,6].

Information on larval dispersal is necessary for the management and conservation of fisheries resources including lobster. However, larval dispersal studies for fisheries management and conservation are neglected. Accordingly, the purpose of the study is to develop formulations to protect ecosystems and conserve lobster resources. The study is going to examine the distribution pattern of lobster larvae in a particular spatial system.

2. Research methods

2.1. Time and research location
Data collections were undertaken from the Tawang Beach of the South Sea of Pacitan, East Java (Figure 1). Geographical coordinate of the location was 111º 19' 76", 24" of East longitude and 08º 25' 07, 66" of South longitude. The data collection were carried out from January to February 2019.

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 number and by species.

2.3. Data analysis
The program used for data collection, analyses, and presentations was MicroSoft Excel and SPSS (Statistics Programs for Social Science) software application. Graph performance was produced from MS Excel while the statistical analysis used was Analysis of Variance (ANOVA).

3. Result and discussion
Four species of lobster larvae were found during. Their proportion from the largest to a lesser are: *P. homarus* (Scalloped spiny lobster), *Panulirus ornatus* (Ornate 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) is likely the most species inhabiting the South Sea of Pacitan.

The ANOVA test showed that the species composition was significantly different (F(4,345) =442.289, P<0.001) (as shown in Table 1). The presence of dominant species, *P. homarus* (Scalloped spiny lobster), was significant, followed by the other three species that is *P. penicillatus* (Pronghorn spiny lobster), *P. versicolor* (Painted spiny lobster) and *P. ornatus* (Ornate spiny lobster) (Figure 3). Meanwhile the other two species, i.e.: *P. longipes* (Longlegged spiny lobster) and *P. polyphagus* (Mud spiny lobster) were absent during data collection. It suggests that the South Sea of Pacitan is not a common habitat for lobster larvae of those two species (longlegged and mud spiny lobster). Nor was the season for them both living around. The dominant species *P. homarus* is commonly found in Indian Ocean, due to the species’ habitat preference of the species to rocky sandy sea bottom.

**Table 1.** ANOVA test of between-species effects.

| Source | Type III Sum Square | df | Mean Square | F | Sig. |
|--------|---------------------|----|-------------|---|------|
| Species | 23964.429 | 4 | 5991.107 | 82.537 | .000 |
| Error | 25042.429 | 345 | 72.587 | |
| Total | 58264.000 | 349 | | |
Figure 3. Species composition of lobsters’ larvae from Pacitan, East Java.

The Indonesian archipelagic state lies within the East Indies triangle. It is a small part in the Indo West Pacific Ocean known as a center of origin of dominant marine species. High marine species diversity and evolutionary importance of the area has been a priority consideration in worlds conservation plan [7,8]. Species differentiation study may reflect the development model of dispersal [9]. Dispersal of marine organisms can provide important information for connectivity theory which will support marine conservation plan and design. The formation of Indonesian archipelagic states, including Java Island, was predicted held in Middle Miocene (14 million years B.P.). Crustaceans, lobster in particular, have been living since Late Jurassic era (152 million years B.P.) [10]. The java island (Java trench) is known as a barrier between the Indian and Pacific Ocean.

There were four species of spiny lobsters found along the South Sea of Java, in the Pacitan waters, i.e.: They are Panulirus ornatus (Ornate spiny lobster), 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). The species compositions of lobster larvae were likely patchy between spatial spheres. Within East Java province alone, the species composition among regencies along the southern coast was possibly to be different. Nevertheless, the dominant species was expected to be P. homarus (Scalloped spiny lobster).

The relationship between faunas with their habitat along the Indian ocean [11] is shared between Australia and Indonesia [12]. The share is divided by the West and East Indian Ocean [13]. Within a close distance as well as further, there might be a shared resource due to geological history and oceanography realm. The shapes of the lineage of the organisms are also formed by ocean processes [14]. Further studies on lobster dispersal and distribution based on oceanography processes may necessary to be done.

References
[1] Spalding MD, Fox HE, Halpern BS, McManus MA, Molnar J and Allen GR 2007 Bioscienc 57 573-583
[2] Setyanto A, Soemarno, Wiadnya DGR and Nugroho C 2019 IOP Conference Series: Materials Science and Engineering 546 022024
[3] Herrnkind WF and Butler MJ 1994 Crustaceana 67 46-64
[4] Butler MJ, Paris CB, Goldstein JS, Matsuda H and Cowen RK 2011 Mar. Ecol. Prog. Ser 422 223-237
[5] Hinojosa IA, Green BS, Gardner C, Hesse J, Stanley JA and Jeffs AG 2016 PLoS One 11
[6] Martínez-Calderón R, Lozano-Álvarez E and Briones-Fourzán P 2018 PeerJ 6
[7] Briggs JC 2005 J. Biogeogr 32 1517-1522
[8] Gaston KJ 2003 Nature 421 900
[9] Castelin M, Feutry P, Hautecoeur M, Marquet G, Wowor D and Zimmermann G 2013 Mar. Biol 160 1395-1406
[10] Brown JH and Lomolino MV 1998 J. Biogeogr, Second ed. Sunderland, Massachusetts, (USA: Sinauer Associates, Inc)
[11] Mahyar M, Lars M, Dierk H, Anne B, Nils K and Jennerjahn T 2007 Mar. Micropaleontol 65 96-112
[12] Murgese DS and De Deckker P 2007 Palaeo3 247 382-401
[13] Farhadi A, Jeffs AG, Farahmand H, Rejiniemon TS, Smith G and Lavery SD 2017 BMC Evol Biol 17 195-195
[14] Vogler C, Benzie J, Barber PH, Erdmann MV, Ambariyanto and Sheppard C 2012 PLoS One 7