Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 24(3): 381 – 388 (2020)
www.ejabf.journals.ekb.eg

Growth Performance of Cultivated Spiny Lobster (*Panulirus homarus*, Linnaeus 1758) in Tuban, East Java, Indonesia

Ikmalia Amali[1] and Putri Desi Wulan Sari[2*]

[1] Aquaculture Study Program, Faculty of Fisheries and Marine, Universitas Airlangga, Mulyorejo Street - Campus C, Indonesia 60115
[2] Department of Fish Health and Aquaculture, Faculty of Fisheries and Marine, Universitas Airlangga, Mulyorejo Street - Campus C, Indonesia 60115
***Corresponding Author: putri.dw@fpk.unair.ac.id**

ARTICLE INFO
Article History:
Received: May 10, 2020
Accepted: May 26, 2020
Online: May 29, 2020

Keywords:
Aquaculture.
Growth performance.
Spiny lobster.
Panulirus homarus.
Tuban,
East Java

ABSTRACT

Spiny lobster is one of the potential and important economic fishery commodities. The demand for spiny lobster consumption continues to increase from year to year. Therefore, it is necessary to develop aquaculture efforts to fulfill the demand for lobster. The aim of this research is to observe the growth performance of cultivated spiny lobsters. The working method used in this study was data collection methods, consisting of primary data obtained from direct observations and secondary data obtained from interviews and literature study. The primary data included measurement of water quality, carapace length, Specific Growth Rate (SGR), absolute length growth, and Survival Rate (SR). Secondary data included spiny lobster aquaculture activity obtained from the literature and journal from the previous study.

There are several technical activities of spiny lobster (*Panulirus homarus*) grow-out, which include pond preparation, fry supply, lobster stocking, feeding, measuring water quality, siphoning, and sampling to measure the growth of spiny lobster. The grow-out process of spiny lobster in this study is started from the average length of 10-20 cm, carapace length of 4.05, and weight size of 145.69 gram. The feed that given to the grow-out activity is trash fish and green clams. The parameters of growth measurement include total length, carapace length, and body weight. After reaching harvest size (one-month) of the rearing process, the value of SGR reached 0.15%, 0.5 cm in absolute length growth and 97% in survival rate.

INTRODUCTION

Spiny lobster (*Panulirus homarus*) or commonly referred to as barong shrimp as a local name in Indonesia, is one of the potential and important economic fishery commodities **(Nora *et al*., 2017).** Lobster has become one of the marine biological resources that develop in various countries including Indonesia. Spiny lobster (*Panulirus homarus)* is a group of marine lobster in Indonesia which has a greenish or brownish base color decorated with bright spots scattered throughout the surface of the abdomen segment, and white patches on the legs (**Baharawi *et al*., 2015)**.

Currently, lobster cultivation is still revolving in grow-out activities. According to **Soekendarsi (2013),** lobster grow-out activities are defined by lobster rearing activities starting from fingerlings to adults with the aim of producing adult lobsters that are ready for consumption and to obtain lobster brood stock. Lobster culture can also be done on land using a tub or pond so the lobster can be easily controlled both in terms of feed, water quality, and predators.

The efforts to grow lobsters have been carried out to meet the demand for lobster. Demand for seawater lobster consumption continues to increase from year to year. According to **Investment and One Stop Integrated Services Office (2019)**, marine fisheries production in East Kalimantan Province reached 113,975.5 tons, which includes the lobster commodity. The demand for spiny lobster fingerlings for export increases which results in more expensive price. In July 2013, the individual price around Rp. 13,000 and its reaches Rp. 17,000 - 20,000 in December 2018 **(Maritime and Fisheries Service, 2015)**. This research shows the step of rearing process and growth performance of cultivated spiny lobster which are usually used as an indicator in developing harvest strategy, production, and also updating scientific information about spiny lobster (*Panulirus homarus*) cultivation.

MATERIALS AND METHODS

This research was conducted at the Boncong Sea Cultivation Installation, Tuban, East Java on December 23, 2019 - January 23, 2020. The work method used in this research was descriptive method with aim to accurately and systematically describe a population, situation or phenomenon by observing and mesuring the paramaters (**Wijayanti &Yanuwiadi, 2017**). Data collection method used were primary and secondary data. Primary data is one which is collected by the researcher himself for the purpose of study **(Bhattacharyya, 2006)**. Primary data collected including procedures, length, and water quality measurement, calculation of survival growth rate, absolute length growth, and survival rate. The primary data in the form of observation, interviews, active participation, and using measuring instruments pricisely according to the purpose **(Samara *et al*., 2020)**. Secondary data is that information which is not topical or research-spesific and has been collected and compiled by some other researcher **(Chawla and Sondhi, 2015)**. This data was collected from documentation data, magazines, newspapers, books, research institute, fisheries offices, libraries, report from private parties, and other parties related to the grow-out performance of spiny lobster in cultivated pond.

Sampling was done every two weeks to observe the specific growth rate (SGR), absolute length increase, and water quality. At the end of the grow-out activity, a survival rate (SR) calculation is performed. Calculation of SGR and absolute length growth were based on the formulation by **Johnston *et al*. (2007)** as follows:

$$SGR = \frac{\ln Wt - \ln Wo}{t} \times 100\%$$

SGR = Specific Growth Rate (%)
Wt = Average final weight (gr)
Wo = Average initial weight (gr)
T = Time (day)

$$L = Lt - Lo$$

L = Absolute length growth (cm)
Lt = Average final length (cm)
Lo = Average initial length (cm)

While the survival rate (SR) calculation was based on **Rasidi (2012)** as follows:

$$SR = \frac{Nt}{No} \times 100\%$$

SR = Survival Rate (%)
Nt = Number of fish at the end of the activity
No = Number of fish at the start of the activity

RESULTS

Spiny lobster (*Panulirus homarus*) grow out activities which are cultivated in ponds consist of several stages, including pond preparation, fingerling supply, lobster stocking, feeding, growth monitoring, water quality control, and observation of disease and pests.

Preparation of Grow out Pond

Lobster grow out concrete pond measuring 1 x 2.5 x 1.5 m with a thickness of 16 cm. Preparation of the grow-out pond was done by draining the water in the pond then cleaning the pond wall and bottom from moss and dirt by brushing with a wiper and brush. Afterward, three to five shelters sized 2.5 to 4.5 inches in diameter were installed in each pond. Then, six aerated units are installed and then filled with clean seawater to a height of 50 cm which has been treated in a seawater reservoir with 100 ml probiotics **(Mansyur & Tangko, 2008).** Shelter used in this study was PVC (Polyviniyl Chloride) type shelter as previous study (**Djai *et al*., 2017**).

Provision of Spiny Lobster (*Panulirus homarus*)

The spiny lobster that will be stocked for the grow-out activities is obtained from fishers and collectors from Tuban coastal area, Indonesia. Spiny lobster is selected by measuring the weight, carapace length, and total length. Spiny lobster (*Panulirus homarus*) is generally characterized by parts of the body that are dominated by greenish color and there are large and small spots in bright yellow color. Based on **Carpenter and Niem (1998); Holthuis (1991)**, spiny lobster (*Panulirus homarus*) is characterized by the tubular body or slightly flattened dorsoventrally, presence of spine on the carapace, no rostrum, and pincers in the 3 first legs, flagella of antenulla long, whip-like and longer than peduncle of antennules, also has transverse gooves on each abdominal somite.

The lobster stock for maintenance activities at the Boncong Sea Aquaculture Installation is obtained from natural catches. During the acclimation process, lobsters that are ready to move will come out by themselves from a plastic basket.

(a) (b)

Figure 1. Spiny lobster (*Panulirus homarus*). (a). Dorsal view; (b). Ventral view

Spiny Lobster Stocking

The lobster was stocked in the morning. Before the lobster is stocked in the rearing pond, the lobster is acclimatized. The acclimatization process aims to adapt the spiny lobster (*Panulirus homarus*) to environmental and water quality conditions in the maintenance pond so it does not cause stress and death. Acclimatization is done by floating a plastic basket containing lobster ready to be stocked on the surface of the grow-out pond for 5-10 minutes. The lobster is stocked in a grow-out pond by opening the plastic basket lid and letting the lobster come out on its own. The stocking density of lobsters is 10 in each rearing pond **(Setyono, 2006).**

Feeding

The main feed given to lobster grow-out activities is trash fish and green mussels as a substitute feed if the trash fish runs out. Feeding is carried out three times a day, including in the morning after spraying at 09.00, in the afternoon at 13.00 and in the afternoon at 16.00. The method of feeding lobster is ad libitum. The total feed given is approximately 44.54 grams per day for every 10 animals. The type of trash fish that is often used as lobster feed is *sardinella* sp., pompano, and others. The trash fish that will be given to the lobster is cut into small pieces using scissors. Green mussels that are used for lobster feed are obtained from the floating net cage area of the grouper in Boncong Marine Aquaculture Installation. The number of green mussels in floating net cages is abundant and can be used as a lobster feed.

Growth Measurement

The measurement of the growth of spiny lobster (*Panulirus homarus*) is done through sampling every two weeks. The frequency of sampling is done by considering the stress level in the spiny lobster. Sampling was carried out by taking ten lobsters in two grow-out ponds then weighing, measuring body length (total length), and carapace length. Growth measurement includes the calculation of Specific Growth Rate and absolute length growth. The final sampling yielded an average weight of 149.3 grams, a total length of 15.85 cm, and a carapace length of 4.32 cm. The initial weight and average length from stocking until final sampling has increased.

Table 1. **Spiny Lobster (*Panulirus homarus*) average growth performance in cultivated pond until harvested (one month)**

Size of lobster	Number of samples	Days of rearing	Initial Period		Final Period	
			Carapace length (cm)	Total weight (g)	Carapace length (cm)	Total weight (g)
10 - 15 cm	10	30	4.17	153.67	4.21	149.8
15.1 - 20 cm			3.92	137.71	4.75	148.8
Total			4.05	145.69	4.48	149.3

Based on the formulas and data (Table 1) obtained during the study, the Specific Growth Rate of spiny lobster is 0.15%, the absolute length growth of spiny lobster is 0.5 cm, and the survival rate of spiny lobster is 97%. The three growth parameters measurement is following the opinion of **Sya'roni (2010)** that the maintenance of lobsters on stocking densities of 20 individual/m^2 obtained specific growth on average by a maximum of 1.75%.

The difference in the growth rate during the grow-out process can cause unbalanced competition in getting food to allow cannibalism.

Water Quality Measurement

Water quality control in a lobster grow-out pond is done by measuring the water's physical and chemical parameters. The water quality is checked twice a day in the morning at 09.00 after siphoning and feeding and at 15:00 after feeding. The parameters observed for controlling water quality are temperature, pH, dissolved oxygen (DO), and salinity. Siphoning is an activity to remove dirt that settles at the bottom of the pond by using a hose. It is an effort to maintain water quality to remain stable, which was conducted at least once every day before feeding.

The results of water quality measurements during the study are temperature with a range of 23.8 - 26.8°C, pH ranges from 6.61 - 8.70, DO gets a value of 6.23 - 8.84 ppm, and salinity ranges at 36 – 42 ppt. The value of water quality in the field, when compared with the literature **(Primawati, 2000)**, is quite optimal, including temperatures 25-28 °C, pH 7-8.5, DO 4.2 - 7.5 ppm, and salinity 36 ppt.

Pest and Disease

Pests found at the time of the study were barnacles that lived on the walls and bottom of the grow-out pond. Barnacles do not greatly affect the growth rate of lobsters, but it can affect the level of cleanliness of the lobster grow-out pond. The disease that attacks lobsters has never been found during grow-out activities at the Boncong Marine Aquaculture Installation. This could be due to the lobster environment is quite good and does not hinder the lobster's immune system.

DISCUSSION

Spiny lobster grow-out activities were carried out in ponds with concrete construction. A concrete pond is a pond in which bottoms are made of concrete and are commonly used in maintenance activities of fisheries commodities. The advantage of lobster grow-out using ponds is that it is easy to control the cannibalism nature and disease attacks **(Setyono, 2006).**

Based on Table 1 it is known that there is an increase in the growth value of spiny lobster. An increase in growth is due to appropriate feeding, which uses trash fish and green mussels as substitute feed. According to **Yolanda *et al.* (2013),** trash fish has fairly complete nutritional content with a protein content of 44%. While according to **Eshmat *et al*. (2014),** green mussels have the nutritional content of 40.8% water, 21.9% protein, 14.5% fat, 18.5% carbohydrate, and 4.3% ash, where 100 grams green mussels containing 100 grams of calories. **Setyono (2006)** stated that the average daily feed requirement is around 7% of body weight. In addition, green mussels are suitable as lobster feed because lobsters are omnivores, which also feeds on mollusks and crustaceans **(Lipcius and Egglestone, 2000)**. The feed given to lobsters in the form of living biota is intended to maintain water quality so that it does not decrease due to uneaten feed and feces.

Specific Growth Rate (SGR) functions to calculate the percentage of daily lobster growth. According to **Rasidi (2012)**, specific growth rates explain that shrimp or fish can utilize feed nutrients to be stored in the body and convert as energy. SGR value in this study (0.15%) is similar with the research conducted by **Vijayakumaran *et al*. (2010)**, but it is higher when compared to research conducted by **Sumbing *et al*. (2016)** with SGR value of 0.125%. The higher SGR in this study was because of not only its appropriate feeding activity but also better shelters compare with previous study **(Sumbing *et al*., 2016).** Lobsters need shelter to protect themselves when molting **(Romano and Zeng, 2017).** Molting is the shedding of the

exoskeleton in crustaceans replaced with new skin to achieve growth **(Chang and Mykles, 2011)**, which in this molting conditions, lobsters are in a softer shell, low feeding abilities and easily attacked by predators **(Keppel *et al*., 2012).** Therefore it is necessary to have a shelter for moulting safely and without stress. The growth rate also depends on the frequency of molting and changes in size per molting **(Fernandez and Radhakrishan, 2016**). Providing adequate feed and shelter will reduce lobster stress.

Absolute length growth is the difference between the length at the end of the grow-out activity with the initial stocking length. Some lobster will have faster weight growth **(Kembaran *et al.*, 2015; Pratiwi, 2018)** than carapace growth, while some lobster will have the opposite **(Yonvitner *et al.*, 2019; Tomi, 2019)**. Several factors can affect the difference growth of carapace length and body weight include temperature, salinity, ecological factors, food and other factors such as sex, age, time and catchment area **(Wahjudin *et al*., 2017; Rohmayoni *et al*., 2018; Beni *et al.*, 2020)**. Information about the length-weight relationship usually used for exploitation needs.

SR value of 97% can be caused by lobster conditions that are safe against cannibalism during the molting process. **Johnston *et al*. (2007)** stated that the absence of predators and the availability of shelters that support the cultivation system can reduce mortality, especially when molting to avoid the threat of cannibalism. Cannibalism is a problem that often arises in the process of lobster grow-out, especially in the phase after molting (post molt). The difference in the rate of growth in the commodities that are maintained can cause unbalanced competition in getting food so cannibalism occurs. The availability of adequate feed and the use of shelter in the culture system is reported to reduce the level of lobster cannibalism **(Crear *et al*., 2000).**

CONCLUSION

Spiny lobster (*Panulirus homarus*) grow-out technique in aquaculture activities is a series of activities that begin from the preparation of maintenance ponds to controlling pests and diseases. Proper feeding can increase the growth value of spiny lobsters. Further studies need to be carried out the procurement of seeds in aquaculture activities so as not to rely on nature.

REFERENCES

Baharawi, S.; Amalia, L.; Efendi, R.; Kembaren, D.; Husen, F.; Warsito.; Siswanto and **Prabowo**. **(2015).** Small Scale Fisheries Guide Series. Sea Lobster Fishing. Issue 1. WWF-Indonesia, 7pp.

Bhattacharyya, D.K. (2006). Research Methodology, second ed. Excel Books, India

Beni.; Zairon, Y and **Wardiatno**. **(2020).** Biological Aspect of double-spined rock lobster (*Panulirus penicillatus*) in Wonogiri Regency Waters, Central Java, Indonesia. IOP Conf. Series : Earth and Environmental Science, **420** : 012006.

Carpenter, K.E. and **Niem, V.H. (1998).** FAO Species Identification Guide for Fishery Purposes. The Living Marine Resource of The Western Central Pacific. Seaweeds, Corals, Bivalves and Gastropods, Vol. 1. Rome.

Chang, E. S. and **Mykles, D. L. (2011)**. Regulation of Crustacean Molting: A Review and Our Perspectives. General and Comparative Endocrinology, **172** (3) : 323-330.

Chawla, D. and **N. Sondhi. (2015)**. Research Metholodyg : Concepts and Cases, second ed. Vikas, India.

Djai, S.; Supriyono, E.; Nirmala, K. and **Adiyana, K. (2017).** Total Haemocyte Count and Hemolymph Glucose Concenration Response of Spiny Lobster *Panulirus homarus* on Ratio of Shelter. JITKT., **9** (1) : 125-133.

Eshmat, M.E.; Mahasri, G. and **Rahardja, B.S. (2014).** Analysis of Lead Metal (Pb) and Cadmium (Cd) content in Green Shells (*Perna viridis* L.) in Ngemboh waters, Gresik Regency, East Java. JIPK., **6** (1) : 101 – 108.

Fernandez, R., and **Radhakrishnan, E. V.** (2016). Effect of Bilateral Eyestalk Ablation on Ovarian Development and Moulting in Early and Late Intermoult Stages of Female Spiny Lobster *Panulirus homarus* (Linnaeus, 1758). Invertebrate Reproduction & Development, **60** (3), 238-242.

Holthuis, L.B. (1991). FAO Species Catalogue. Marine Lobster of The World. An Annotated and Illustrated Catalogue of Species of Interest to Fisheries Known to Date, Vo. 13. Rome.

Investment and One Stop Integrated Services Office. **(2019)**. Study of Lobster Investment Potential Mapping in East Kalimantan. Investment and One Stop Integrated Services Office. Samarinda. pp 1-2.

Johnston, D.; Melville-Smith, R and **Hendriks, B. (2007).** Survival and Growth of Western Rock Lobster *Panulirus cygnus* (George) Fed Formulated Diets with and without Fresh Mussel Supplement. Aquaculture, **273** (1) : 108-117.

Kembaren, D. D.; Lestari, P. and **Ramdhani, R. (2015).** Biological Parameters of Sand Lobster (*P. Homarus*) in Tabanan Waters of Bali. Bawal, **7** (1) : 35-42.

Keppel, E. A.; Scrosati, R. A.; and **Courtenay, S. C. (2012).** Ocean Acidification Decreases Growth and Development in American Lobster (*Homarus americanus*) larvae. JNAFS., **44** *:* 61-66.

Maritime and Fisheries Service. (2015). Study/Analysis of Lobster (*Panulirus* sp.) Seed Management in West Nusa Tenggara Province. Maritime Affairs and Fisheries Office of West Nusa Tenggara Province. Mataram. pp 1-2.

Liliyanti, M.A.; Ali, M. and **Faturrahman**. **(2016)**. Growth of Spiny Lobster (*Panulirus homarus*) in The Integrated Multi Tropic Aquaculture System. IRJNAS., **3** (8) : 55-67.

Lipcius, R.N. and **Egglestone, D.B**. **(2000)**. Ecology and Fishery Biology of Spiny Lobster in Phillips, B.F and Kittaka, J (eds) Spiny Lobsters : Fisheries and Culture. Blackwell Science. Oxford. pp 1-41.

Mansyur, A. and **Tangko, A. M**. (2008). Probiotics: Utilization for low quality fish feed. Media Akuakultur, **3** (2): 145-149.

Nora, S.E.; Oktaviani. R.; Hartoyo, S. and **Priyarsono, S.D**. **(2017).** Technical Efficiency of Lobster Enlargement Business in Lombok Island, West Nusa Tenggara. *JMA*., **14** (3) : 231.

Pratiwi, R. (2018). Diversity and Potential of Lobster (Malacostraca: Panuliridae) on Pameungpeuk Beach, South Garut, West Java. Biosfera, **35** (1) : 10-22.

Primawati, Y. (2000). Study of Lobster Catches (*Panulirus* spp.) In Pangandaran Waters. Thesis. Faculty of Fisheries and Marine Science. Bogor.

Rasidi. (2012). Growth, survival and nutrient content of the worms Polychaeta *Nereis diversicolor* (O.F. Muller, 1776) fed different types of feed and the study of the use of polychaeta by the community as broodstock feed in shrimp hatchery. Thesis. Graduate Program Universitas Indonesia. Jakarta. pp 107.

Rohmayani, V.; Pahlevi, M.R.; Irawan, B. and **Soegianto, A**. **(2018)**. Length-Weight Relationship, Sex Ratio and Condition Factor of Blue Swimming Crab (*Portunus pelagicus* Linnaeus, 1758) from Java Sea Indonesia. AIP Conf. Proceedings, **2002** : 020071.

Romano, N. and **Zeng, C. (2017).** Cannibalism of Decapod Crustaceans and Implications for Their Aquaculture: A Review of Its Prevalence, Influencing Factors, and Mitigating Methods. Reviews in Fisheries Science & Aquaculture, **25** (1) : 42-69.

Samara, S.H.; Fathurrozi, A.Q. and **Sutarno. (2020)**. Selektive Breeding Technique : Pandu and Kunti Tilapia (*Oreochromis niloticus*) broodstock candidates at PBIAT Janti, Klaten-Central Java. IOP Conf. Series : Earth and Environmental Science, **441** : 012006.

Setyono, D. E. D. **(2006)**. Shrimp Enlargement Cultivation of Shrimp (*Panulirus* spp.). Oseana, **31** (4) : 39-48.

Soekendarsi, E. (2013). Types of Lobster in Pangandaran Waters, Ciamis Regency. Jawa Barat. Pusat Penelitian Oseanografi. LIPI. Jakarta.

Sumbing, M.V.; Al-Azad, S.; Estim, A. and **Mustafa, S. (2016)**. Growth Performance of Spiny Lobster *Panulirus ornatus* in Land-Based Integrated Multi-Trophic Aquaculture (IMTA) System. Transactioins on Science and Technology, **3(1-2)** : 143-149.

Sya'roni. M. (2010). Effect of Stocking Dense Differences on Growth Rate of Post Puerulus Lobster Sand (*Panulirus homarus*) in Nursery Phase. Thesis. Univesitas Mataram.

Tomi, S. (2019). Assessment of Sand Lobster (*Panulirus homarus*) Resources in Palabuhanratu Waters of Sukabumi, Wes Java, Indonesia. RJOAS, **6** (90) : 51-59.

Vijayakumaran, M.; Anbarasu, M. and **Kumar, T.S. (2010)**. Moulting and Growth in Communal and Individual Rearing of The Spiny Lobster, *Panulirus homarus.* J. Mar. Biol. Ass. India, **52** (2) : 274-281.

Wahjudin, R.A.; Hakin, A.A.; Qonita, Y.; Boer, M.; Farajallah, A.; Mashar, A. and **Wardiatno, Y. (2017).** Lobster DIversity of Palabuhanratu Bay, South Java, Indonesia with New Distribution Record of *Panulirus ornatus*, *P. Pluphagus* and *Parribacus antarcticus.* AACL Bioflux, **10** (2) : 308-327.

Wijayanti, D. A.; Hertika, A. M. S. and **Yanuwiadi, B**. **(2017)**. The Perceptions of Community on The Role of Kijing Taiwan (*Anodonta woodiana*) in Freshwater Aquaculture Ponds. Indonesian Journal of Environment and Sustainable Development, **8** (1) : 49 - 52.

Yonvitner, Z.; Imran, S.; Martasuganda, B.O.; Nababan, F.M.; Tokan, S.D.; Cahyo, R.A. and **Ramadhan. (2019)**. Parameter Population Parameter in Bumbang Bay, Central Lombok. JIPK., **11** (2) : 40-50.