Original Research Article

ANALYSIS OF DIFFERENT DEPTH AND TYPES OF FEED ON THE GROWTH OF SPINY LOBSTER (*Panulirus homarus*) USING THE VIETNAMESE CAGE METHOD IN PANTAI TIMUR, KABUPATEN PANGANDARAN

ABSTRACT

The purpose of this research is to find out the effect of different depths and types of feed on the growth of spiny lobsters (*Panulirus homarus*) Vietnamese cage system on the Pantai Timur Pangandaran. It is expected to provide information to spiny lobster cultivators about the effect of different depths and types of feed on the growth of spiny lobsters (*Panulirus homarus*) Vietnamese cage method on the Pantai Timur Pangandaran. Maintenance of test animals was carried out for 40 days using cages with a diameter of 80 cm and a height of 90 cm. Each container contains 15 lobster seeds. The frequency of feeding is 2 times a day in the morning at 7.00 and afternoon at 16.00. The amount of test feed given is 20% of the lobster weight for one day. In addition, the mortality rate of lobsters was also observed by looking at the number of lobsters that died each day. Then sampling activities are carried out every 10 days to measure the growth of lobsters so that their growth rate can be observed. Measurement of water quality as supporting data to determine the effect of the feed on water quality and determine the feasibility of water quality is carried out once every 10 days together with the sampling time. Some of the parameters observed were temperature, salinity, dissolved oxygen, and degree of acidity (pH). Lobster growth performance from sampling every ten days showed that treatment C (placement of cages at a depth of 5 meters) was the best, with a daily growth rate (DGR) of 1.97%, and Feed efficiency of 15.01%. This shows that good water quality will affect the survival of fish and their growth. Suggestions that can be put forward so that research will be even better in the future is the addition of a shelter or hiding place for lobsters that are in the process of molting.

Keywords: Spiny Lobster, DGR, Feed Efficiency, Depth, Feed

1. INTRODUCTION

Marine aquaculture (mariculture) has not been widely carried out, while natural resources are very adequate and the availability of marine fish for various needs is still insufficient. Lobster cultivation in the country is one of the solutions to maintain the availability of lobster seeds in the waters. Opportunities for domestic lobster cultivation are very wide open due to the lack of cultivation activities in seawater, including the cultivation of lobsters themselves. This is certainly an opportunity that can be exploited considering that the natural conditions in Indonesia itself support the potential for lobster cultivation and are currently becoming a national issue.

Lobster (*Panulirus sp*.) is a marine animal that belongs to the crustaceans or crustaceans that have hard skin and belong to the arthropod group. Has five life phases starting from the egg sperm production process, then the puelurus or larval, post-larval, juvenile, and adult phases. Lobsters are nocturnal animals that are active at night, and during the day preferring to stay in coral holes and later at night come out of hiding to look for food around shallower corals during high tide. Sea lobsters live in rocky, and spinyy waters. There are at least seven species of lobster in Indonesia, namely Scallop Spiny Lobster (*Panulirus homarus*), Batik Lobster (*Panulirus longipes*), Rock Lobster (*Panulirus penicillatus*), Pakistan Lobster (*Panulirus polyphagus*), Pearl Lobster (*Panulirus ornatus*), Bamboo Lobster (*Panulirus versicolor*), and Red Batik Lobster (*Panulirus femoristriga*).

Lobster rearing is generally carried out in floating net cages to provide the advantage of living in their natural habitat. However, the use of marine cages with surface netting has a drawback where the quality of the waters can easily change due to weather changes. On the other hand, lobsters are sensitive to environmental changes. Therefore, the use of floating net cages with the Vietnamese-style cage method is thought to be a solution for lobster cultivation in Indonesia.

One of the things that need to be considered in cultivation activities is feeding. Feed is one of the most important aquaculture inputs because production costs derived from feed can reach 60% (Afrianto and Liviawaty 2005) [1]. Lobster hatchery technology commercially has achieved various concepts but has not been realized significantly. Commercial production of puerulus produced in hatcheries could be implemented in the next few years [2].

The feed used for lobster cultivation currently still relies on natural foods such as trash fish, crustaceans, squid, and shellfish. However, trash feed is usually used by farmers. Feeding the trash usually creates problems, especially if the enlargement of lobsters is carried out intensively. These problems include: The availability of trash feed which is difficult to fulfill consistently because it depends on the catch, The quality of the trash varies, Lobster has the potential to be a carrier of a disease, and Lobster gives a high amount of waste.

Lobsters are omnivorous animals that tend to be carnivorous, so they require a fairly high protein. Protein in the feed affects the growth of lobsters. The composition of the trash fish feed has a higher protein content than the artificial feed. The trash fish feed, although it has a fairly high protein and energy content, in terms of the balance of nutritional value, is almost the same as the artificial feed.

Based on the description above, a study was conducted on the analysis of the influence of water quality at different depths on the growth of spiny lobsters (*Panulirus homarus*) using the Vietnam-style cage method to determine how much influence water quality has with different depths and types of feed on the growth of spiny lobsters.

2. MATERIAL AND METHODS

This research will be carried out in floating net cages on Pantai Timur, Kabupaten Pangandaran for 40 days starting in September 2022 – November 2022.

The tools that will be used during the research are; AQUATEC brand Lobster Cage as a maintenance container, digital scale with an accuracy of 0.1 gram, used to weigh the weight of lobsters and feed, baskets to accommodate trash fish and crustaceans as lobster feed, Steel Scissors to cut trash fish, DO meter to measure the dissolved oxygen content of the waters, a pH meter to measure the degree of acidity of the waters, and a thermometer to measure the temperature of the waters.

Figure 1. Spiny Lobster (*Panulirus homarus*)

The materials used during the research were lobster seeds measuring 30-40 grams obtained from around 300 fishermen, as well as trash fish and crustaceans obtained from local fishermen as test feed in this study.

Research methods

The method used in this study was an experimental method with a completely randomized design (CRD) consisting of 3 depth treatments, 2 feed treatments, and 3 replications.

- Treatment A: Trash fish feed to the cage with 2 meters depth.
- Treatment B: Trash fish feed to the cage with 3,5 meters depth.
- Treatment C: Trash fish feed to the cage with 5 meters depth.
- Treatment D: Crustacean feed to the cage with 2 meters depth.
- Treatment E: Crustacean feed to the cage with 3,5 meters depth.
- Treatment F: Crustacean feed to the cage with 5 meters depth.

Data were analyzed descriptively. Then the effect of each treatment was tested by analysis of variance (ANOVA) F test at a 5% test interval, if there was a significant difference it was continued with Duncan's multiple range test.

This research began with preparing the tools and materials to be used in the research, the seeds used during the research came from local fishermen's catches, the maintenance containers used cages from AQUATEC products, as well as the maintenance of lobsters which were treated with different depths and types of feed along with the results of the research in the form of analysis data.

Lobster Seed Preparation

The seeds obtained came from fishermen around the Pantai Timur Pangandaran. The seeds used in this study were about 30-40 g in size.

Maintenance Container Preparation

The maintenance container used was a cage with a diameter of 80 cm and a height of 90 cm. The cage is placed by being tied to a supporting pole in the Marine KJA and submerged 2-5 m deep. Each cage was given a treatment sign to facilitate research.

Figure 2. Lobster Culture Cage During The Research

Lobster Maintenance

During the lobster rearing period, the feed was carried out every day with a frequency of feeding 2 times a day and the amount of test feed given was 20% of the fish weight for one day. In addition, the degree of mortality of lobsters was also observed by looking at the number of lobsters that died each day. Then sampling is carried out every 10 days to measure the growth of the lobsters so that the growth rate and feed efficiency can be observed. In addition, water quality is measured as supporting data to know the effect of the feed on water quality and to determine the feasibility of water quality using several existing parameters.

Observation Parameters

Survival Rate (SR)

Survival is calculated using the formula (Effendi 2002) [3] :

$$SR = \frac{Nt}{N0} x\ 100\%$$

Information : SR = Survival (%)
Nt = Number of fish on day t (heads)
No = Number of fish on day 0 (heads)

Daily Growth Rate (LPH)

Fish growth parameters are calculated using the daily growth rate formula (Effendi 2002) [3]:

$$G = \frac{lnWt - lnWo}{t} \times 100\%$$

Information: G = Daily growth rate (%)
Wt = average seed weight at the end of the study (g)
Where = average seed weight at the start of the study (g)
t = Fish rearing time (days)

Feeding Efficiency (EPP)

Feeding efficiency can be calculated using the formula (Tacon 1993 in Amalia 2013) [4]:

$$EPP = \frac{Wt - W0}{F} \times 100\%$$

Information : EPP = Feeding Efficiency (%)
F = Amount of feed given during the study (g)
Wt = average seed weight at the end of the study (g)
Where = average seed weight at the start of the study (g)

Food Convention Ratio **(FCR)**

Feed conversion is calculated using the formula (Fahrizal and Nasir 2017) [5] namely:

$$FCR = \frac{F}{(Wt + D) - WHERE}$$

Information: FCR = Feed conversion ratio/feed conversion ratio.
F = Amount of feed given (g).
Wt = Weight of test fish at the end of the research (g).
D = Weight of dead fish (g).
Where = Weight of test fish at the beginning of the research (g).

Water Quality Parameters

Observation of water quality was used as a supporting parameter during the research. Water quality parameters measured during the study were temperature, degree of acidity (pH), *dissolved oxygen* (DO), and water salinity.

Data analysis

The results of the data obtained were analyzed descriptively through observational studies with supporting data and related literature. Furthermore, statistical analysis was carried out using a completely randomized design (CRD). The data obtained were analyzed using analysis of variance with the F test to determine the effect of each treatment then to see differences between treatments then continued with Duncan's multiple range test with a confidence level of 95% (Gasperz, 1994) [6].

3. RESULTS AND DISCUSSION

Life sustainability/*Survival Rate* (SR)

Survival (SR) is the ratio of the number of species that live from the beginning to the end of the study. The results of the calculation of the survival rate for 60 days of rearing showed that the highest survival rate was in treatment A (placement of cages at a depth of 2 meters with trash fish feed) at 93.33%, then in treatment B (placement of cages at a depth of 3.5 meters with fish feed trash) C (placement of cages at a depth of 5 meters with trash fish feed), and E (placement of cages at a depth of 3.5 meters with crustacean feed) of 90% and treatment D (placement of cages at a depth of 2 meters with crustacean feed) and treatment F (placement of cages at a depth of 5 meters with crustacean feed) of 83.3%. The survival rate of lobsters was not significantly different for each treatment with the best treatment in treatment A. The results of observing the survival rate of lobsters can be seen in Table 1.

Table 1. Average Lobster Survival During the Study

Treatment	Feed	Depth	Rate-Rate (%)
A	Trash fish	2 m	93,33
B	Trash fish	3,5 m	90,00
C	Trash fish	5 m	90,00
D	Crustacean	2 m	83,33
E	Crustacean	3,5 m	90,00
F	Crustacean	5 m	83,33

The data obtained show that the treatment given does not have a significant effect on the survival rate of the lobster itself. Because each treatment given has results that are not significantly different. This is presumably because the quality of the water in the research location is still good for aquaculture activities. The optimal salinity for lobster growth ranges from 29-34 ppt. This salinity range can support the life of lobster seeds properly and can directly affect the growth rate, amount of food, and survival power of lobsters in nature. This following the results of research from Utami (2022) [7] which showed that the depth of the culture container did not affect the survival rate of lobsters.

Daily Growth Rate (DGR)

Fish growth is influenced by internal factors and external factors. Internal factors include heredity, sex, and age while external factors include food and water quality (Effendie 1997) [8]. The daily growth rate serves to calculate the percentage of fish growth per day.

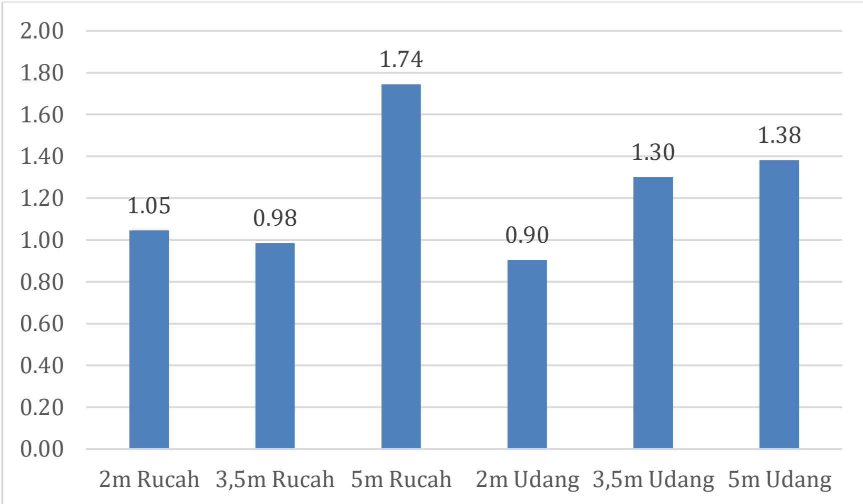

Figure 3. Daily Growth Rate of Spiny Lobster for 40 Days

Based on Figure 3, it can be seen that the daily growth rate of spiny lobsters ranges from 1.01% to 1.97%. The highest daily growth rate value was in treatment C (placement of cages at a depth of 5 meters with trash fish feed). treatment of 1.97%, then followed by treatment F (placement of cages at a depth of 5 meters with crustacean feed) of 1.70%, treatment E (placement of cages at a depth of 3.5 meters with crustacean feed) of 1.67%, treatment Treatment B (placement of cages at a depth of 2 meters with trash fish feed) was 1.09%, treatment A (placement of cages at a depth of 3.5 meters with trash fish feed) was 1.06%, and the lowest daily growth rate was treatment D (placement of cages at a depth of 2 meters with crustacean feed) with a value of 1.01%.

Table 2. Duncan's Multiple Distance Test Daily Growth Rate (DGR)

Treatment	Feed	Depth	Average Daily Growth Rate (%)
A	Trash fish	2 m	1,06±0,081 ab
B	Trash fish	3,5 m	1,09±0,189 bc
C	Trash fish	5 m	1,97±0,023 de
D	Crustacean	2 m	1,01±0,195 a
E	Crustacean	3,5 m	1,68±0,473 d
F	Crustacean	5 m	1,70±0,115 de

Note: Values followed by the same letter are not significantly different according to Duncan's multiple range test at the 95% level of confidence

From the table above, it can be said that there is a significant difference between the treatments with a 95% confidence level. However, in treatment C the results showed a significant difference. This shows that treatment C is the optimal treatment in the enlargement stage of lobsters with a size of 30-40 g with a treatment depth of 5 meters and feeding trash fish. In addition, in the treatment with crustacean feeding, the E and F treatment which used a depth of 3.5 and 5 meters also had the highest growth and have the same notation with treatment C which meaning they didn’t have significant difference.

This is presumably because the temperature has an important role in the process of growing lobsters, high-temperature increases can result in slow lobster growth, and lobsters can grow well in the temperature range of 24°C - 32°C (Damis et al. 2015) [9]. The temperature in treatments C and F (placement of cages at a depth of 5 meters) tends to be more stable because it has a depth of 5 meters and is the limit where it is not too affected by sunlight so that the temperature changes that occur are not too significant. This is following the results of research from Fitzgibbon et al. (2017) [10] which states that the best growth results are found at optimal temperatures and will decrease with increasing temperature and are directly proportional to the results of research from Taufiqurrahman (2022) [11] which states that a depth of 5 m produces the best growth in growing lobsters in sinking net cages.

Feeding Efficiency

Feeding efficiency is the ratio between the resulting body weight gain and the total feed used during the rearing period. The greater the feed efficiency value produced, the better the feed utilization process by the fish so that the resulting weight increases. Factors that affect the efficiency of feeding include the amount of feeding, the amount of feed consumption (feed energy content), as well as the completeness of nutrients in the feed (Djadjasewaka 1985) [12].

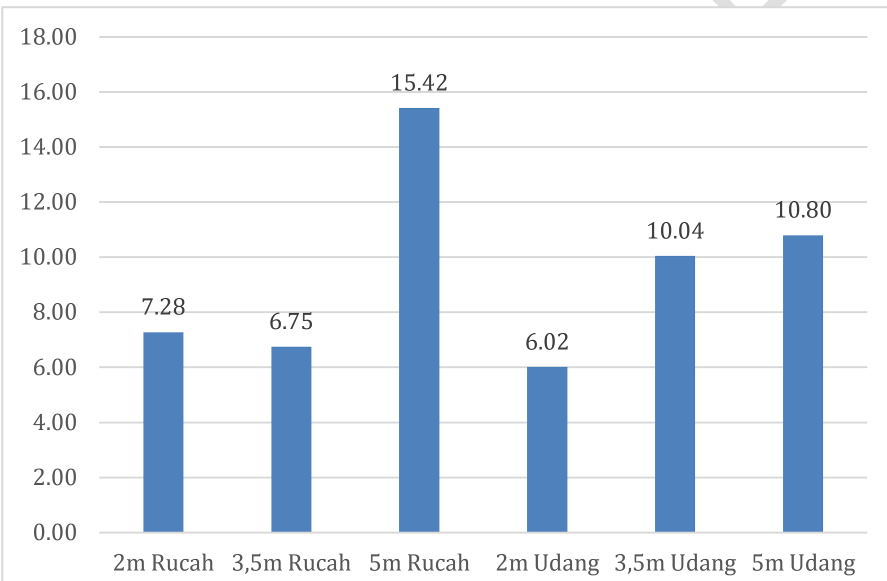

Figure 4. Spiny Lobster Feeding Efficiency for 40 Days

Based on Figure 4, it can be seen that the efficiency rate of feeding spiny lobsters ranges from 6.29% to 15.01%. The highest daily growth rate value was in treatment C (placement of cages at a depth of 5 meters with trash fish feed). 15.01%, then followed by treatment E (placement of cages at a depth of 5 meters with crustacean feed) at 12.36%, treatment F (placement of cages at a depth of 3.5 meters with crustacean feed) at 12.17%, treatment Treatment B (placement of cages at a depth of 2 meters with trash fish feed) was 6,91%, treatment A (placed with cages at a depth of 3.5 meters with trash fish feed) was 6.64%, and the lowest daily growth rate was treatment D (placement of cages at a depth of 2 meters with crustacean feed) with a value of 6.29%.

Table 3. Average Lobster Feed Efficiency

Treatment	Feed	Depth	Average Lobster Feed Efficiency
A	Trash fish	2 m	6,64±0,625 ab
B	Trash fish	3,5 m	6,91±1,508 bc
C	Trash fish	5 m	15,01±0,254 de
D	Crustacean	2 m	6,29±1,452 a
E	Crustacean	3,5 m	12,36±4,385 de
F	Crustacean	5 m	12,17±1,126 e

Note: Values followed by the same letter are not significantly different according to Duncan's multiple range test at the 95% level of confidence

From the table above, it can be said that there is a significant difference between the treatments with a 95% confidence level. However, in treatment C the results showed a very significant difference. This shows that treatment C is the optimal treatment in the enlargement stage of lobsters with a size of 30-40 g with a treatment depth of 5 meters and feeding trash fish. The greater the feed efficiency value, the more efficiently the fish utilize the feed consumed for their growth Iskandar (2015) [13]. Lobster feed efficiency and high feed efficiency in treatment C are suspected because the feed given is more utilized by lobsters, this is because the feed is spread evenly by underwater currents and not at one point so there is no competition between lobsters. In addition, constant levels of salinity do not change affecting the metabolism of lobsters for growth, so lobsters make better use of the feed given. This is following the statement of Kusumaningtyas et al. (2014) [14], water quality plays an important role in the field of fisheries, especially for aquaculture activities and in the productivity of aquatic animals. The feed efficiency value is also directly proportional to the FCR value in the rearing medium.

This is following Julianti's research (2022) [15] which states that productivity, feed conversion, and growth of lobsters in the enlargement stage in floating net cages sinking at a depth of 5 meters give better results compared to shallower depths and is also following the statement from Fitzgibbon et al. al. (2017) [10] where the feed conversion ratio will increase along with the increase in water temperature when raising lobsters. This means that the FCR value also depends on the depth of the location of the lobster culture media. The deeper the cage is submerged, the lower the water temperature will be which will result in a lower FCR value.

Water Quality Parameters

One of the factors that influence fish growth is water quality. (Aquarista et al., 2012) [16] stated that the importance of managing water quality for aquaculture purposes is because water is a living medium for aquaculture organisms. Water quality plays an important role in the field of fisheries, especially for aquaculture activities and in the productivity of aquatic animals. According to Kusumaningtyas et al. (2014) [14] several parameters that can determine the water quality of water are temperature, salinity, degree of acidity (pH), and dissolved oxygen (DO). The average water quality parameters can be seen in table 4.

Table 4. Average Water Quality Parameters

No	Treatment	Depth	Observation Parameters			
			DO (mg/L)	Temperature (°)	pH	Salinity (ppt)
1	A &D	2,5	6,5	28	8	33
2	B & E	3,5	5,55	28	8	34
3	C & F	5	5,22	28	7	34

Salinity

Salinity is the level of dissolved salt levels in seawater. The increase in salinity is also affected by the reduced influence of freshwater input from the mainland along with increasing depth. Fresh water that enters the waters has a lower mass of water so the mass of the water will be above the mass of water with high salinity (Sidabutar et al. 2019) [17]. There was no significant difference in the salinity values obtained from each treatment in this study. The results of salinity measurements showed that treatments A and D (placement of cages at a depth of 2.5 meters) had a salinity value of 33ppt. Whereas treatments B and E (placement of cages at a depth of 3.5 meters) and C and F (placement of cages at a depth of 5 meters) had a salinity value of 34ppt.

Temperature

Water temperature is a very important factor for the life of organisms in the waters. Temperature is one of the easiest external factors to study and determine. Metabolic activity and the distribution of aquatic organisms are heavily influenced by water temperature (Hamuna et al. 2018) [18]. The results of temperature measurements taken every seven days during the rearing period did not have a large difference between the treatments, which was in the range of 27-30°C, and the average for each treatment was 28°C.

As stated by Kemp and Britz (2008) [19] in their research, shows that good lobster survival is at temperatures ranging from 19 to 28 °C with temperature affecting growth rate, feed consumption, and feed conversion ratio parameters. The gradual growth trait associated with molting is one of the characteristics that lobsters grow. In terms of increased carapace weight or length, and frequency of molting.

Dissolved Oxygen (DO)

Dissolved oxygen or commonly abbreviated as DO is one of the parameters used to measure water quality. Dissolved oxygen is very beneficial for the survival of marine life. Dissolved oxygen can be formed from the transfer of substances with high to low concentrations or diffusion, in this case, the air will transfer into the water, besides that dissolved oxygen can also be formed due to the photosynthetic process of plants found in the ocean (Mubarak et al. 2010) [20]. Based on test results in research activities, it was shown that in treatments A and D (placement of cages at a depth of 2.5 meters) a doing value of 6.5 mg/l was obtained. While treatments B and E (placement of cages at a depth of 3.5 meters) and C and F (placement of cages at a depth of 5 meters) obtained values of 5.55 mg/l and 5.22 mg/l.

Degree of Acidity (pH)

The pH value is used to express the degree of acidity or alkalinity of a solution. The degree of acidity (pH) is the negative logarithm of the concentration of hydrogen ions released in a liquid and is an indicator of whether water is good or bad. The degree of acidity of water is one of the chemical parameters which is quite important in monitoring the stability of the water. Variations in the pH value of the water greatly affect the biota in water. In addition, the high pH value greatly determines the dominance of phytoplankton which affects the level of primary productivity in waters where the presence of phytoplankton is supported by the availability of nutrients in marine waters (Hamuna et al. 2018) [18]. The weekly pH measurements did not have a significant difference. In treatments A and D (placement of cages at a depth of 2.5 meters) and B and E (placement of cages at a depth of 3.5 meters) the pH level was 8. Meanwhile in treatments C and F (placement of cages at a depth of 5 meters) pH value of 7.

4. CONCLUSION

Spiny Lobster maintenance with different depths and types of feed can affect several parameters, namely absolute weight gain, daily growth rate (LPH), feeding efficiency (EPP), and Feed Conversion Ratio. In this study, the treatment with optimal results was C treatment with a depth of 5 m and the type of trash fish feed which obtained the highest value, namely the Absolute Weight Addition of 51.67 g, LPH of 1.74%, EPP of 15.42% and has the lowest FCR value of 6.51.

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