Re-description of lobster fishery following ministerial decree of marine affair and fisheries 56/2016: case study in Pacitan, East Java

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Abstract. Fishery-based lobster production decreased substantially due to over-exploitation and urge fishermen to catch smaller-size. In early 2015, the Ministry of Marine Affairs and Fisheries restrained catch of species up to 8 cm carapace length or at least 200 g weight. This study to identify species and individual size within catch of two different fishing gears at different fishing ground. “Krendet”, demersal pot (trap) was operated from the cliff of strong reef crest that connected to land-coast with a strong rope. Outside the cliff, fishermen operated gill net. Catch species were identified based on morphology and meristic. Species composition was calculated based on number of each species within catch. The results showed that there were six species was catch: *Panulirus penicillatus*, *P. homarus*, *P. longipes*, *P. ornatus*, *P. versicolor*, and *P. polyphagus*. It represents all lobster species of Indonesia. *P. homarus* dominated the catch at fishing ground outside the pinnacle (63%), and near cliff species was dominated by *P. penicillatus* (69%). Regarding size regulation, only 42% of catch met the carapace length of > 8 cm. Carapace length-weight relationship does not always meet the criteria. These results indicated that part of lobster fishery were exploited undersize exposing the stock under risk.

1. Introduction

Asia is an important continent for the world fish trade, can supply nearly 60% of world fisheries production. Fisheries from countries in Asian Continent such as Bangladesh, India, Indonesia, Malaysia, Philippines, Sri Lanka, Thailand, and Vietnam play an important role in preserving food and providing employment for their people [1]. One of the fisheries that plays an important role is Lobster. The biggest supplier of lobster in the world is Southeast Asia. It is estimated that around 80,000 tons [2].

The percentage of lobster production in Indonesia has decreased from 2001-2008, the one of them is lobster pasir. This decrease production is believed to be one of the consequences of the catching pressure. The impact is smaller size of lobster caught [3].

The decrease value of lobster production in Indonesia has occurred several years ago included in the waters south of Gunung Kidul and Pacitan. Both of these areas, especially in Pacitan have potential areas for catching lobster, because this area included category of good habitat for lobster live, it’s ravines and coral reefs that thrive [4]. Judging from the topography of pacitan composed from hills and mountains, ravines, including a thousand mountain rows and is an ekokarst region. Many ravines and cliffs that are related to the sea make lobsters like this plase for their live.
The development of lobster fishermen in Pacitan Regency needs to be known after the government policy on Ministerial Decree of Marine Affair and Fisheries or PERMEN KP (in indonesia language) Number 56 of 2016. The species are still survive and often caught (species composition), carapace length and weight, and the lobster caught in conditions laying egg also need to be considered still in accordance with listed on the PERMEN KP or not.

2. Materials and methods
2.1 Data collection methods
The study use a descriptive method with quantitative studies, the mean of collecting methods, presenting and analyzing data are used to give good explanation of the object based on study and give the conclusions based on the research. The sample lobster catching from Tamperan Coastal Fishing Port in February-March 2019. The data analysis used descriptive statistical analysis including of descriptions species identification, frequency distribution of carapace lengths and weights, differences in species composition from each fishing ground, distribution of sex, lobster caught in conditions laying egg. The Second is inductive statistical analysis including of data processing results of species composition with Chi-square and One Way Anova.

2.2 Data analysis method
2.2.1. Descriptive statistics analysis
The function of analysis to describe the characteristics of each variable was studied. For numerical data use the mean (average), median, standard deviation and others. As for categorical data, can only explain the numbers/ percentages of the numbers and percentages of each group [5]. Data to be analyzed is bellow:

a. Species identification
Identification species of lobster landed at Tamperan Coastal Fishing Port based on morphological and meristic characteristics using the reference of "The Living Marine Resources of the Western Central Pacific. Volume 2 (Chepalopods, Crustaceans, Holothurians and Shark) Marine Resources Service Species Identification and Data Progframme FAO Fisheries Department [6].

b. Species compotition
The species compotition was calculated based on number of catch from two differences fishing gears at different fishing grounds. The majority of fishing ground A uses gill nets was applied in the water column of the sea and far from the edge cliff. The fishing ground B used fishing gear "krendet" thats operated from the cliff of strong reef crest that connected to land-coast with a strong rope. Descriptively to know species composition using percentage analysis with a modified formula on the study [7] :

\[ K_j = \frac{n_i}{N} \times 100\% \]

Keterangan:
Kj = Spesies Compotition (%)
ni = number of species individu
N = number all of species individu

c. Distribution frequency of carapace length and weight
The analysis of carapace length and weight of sample by the Quantitative Method are statistical method with of numbers, tables and graphs [8]. The frequency data of carapace length and weight were getting from measurements carapace length and weight of lobsters at landing site. The measurement of carapace length starts from tip of the mouth until the base of carapace without touching the abdomen using a calipers with a precision of 0.1 cm / 1 mm. The measurement of lobster weight using a digital scale with a level of accuracy is 1 gram.

d. Distribution of sex and berried conditions when lobster caught
To find out the sex of lobster can confirmed with guidelines from journal references and interview with fishermen. There are 3 distinguishing points based on the morphological characteristics are the location of the genitals between fifth foot (male) and between the third foot (female), the number of swimming foot sheets (pleopod) for males is only one in each branch if the female has two swimming foot sheets (pleopod) in each branch, and the shape in fifth foot point has branches for females and taper branchless for males. Based on ministerial decree of marine affair and fisheries No. 56 of 2016 [9] that catching and/or removing lobsters is not allowed to lay eggs.

2.2.2 Inductive statistical analysis

Inductive statistical data analysis used hypotheses to be tested statistically. First, the composition of lobster catches was tested based on each fishing ground; the analysis used chi-square and One Way Anova.

a. Data analysis with chi-square

The analysis in study site to find out whether there were differences of fishing ground (fishing ground A and B) composition of lobster species caught in Tamperan waters can show the same or the different results. Chi-Square analysis is a method for comparing of frequency that occurs (observation) with the frequency of expectations (expectations). If the observed frequency values with the expected frequency values are same, then there is no significant difference and the otherwise (Fowler and Jarfus 1998). While the statistical tests use the formula [10]:

\[ X^2 = \sum \frac{(O-E)^2}{E} \]

Keterangan:

- O = frequency observe
- E = expected frequency value (expectation)
- df = free degrees \((b-1)*(k-1)\)
- k = number of column
- b = number of row

b. Data analysis with one way ANOVA

If after tested using Chi-Square shows different results, then do test again using the Analysis of Variants (ANOVA) with the F table test and count. ANOVA is used to see the real difference between the average composition of lobster species caught on each fishing ground. This test also requires a hypothesis or initial guess, at each fishing ground (A and B).

3. Result and discussion

3.1 Descriptive statistical analysis

3.1.1 Species identification of lobster

Lobster catches at Tamperan Coastal Fishing Port during the research were identified based on morphology and meristic from Carpenter and Niem's book. Lobsters in the Western Pacific represented 8 families, 22 genera, and 89 species. The most are lobster spiny and slipper (Palinuridae and Scyllaridae), Synaxidae and Enoplometopidae. Palinuridae family has 5 genera are Justitia spp., Linuparus spp., Palinustus spp., Panulirus spp., And Puerulus spp. [6]. The research at Tamperan Coastal Fishing Port focused on genus Panulirus spp, there were only 6 lobster species from the study site that is Panulirus versicolor, Panulirus longipes, Panulirus penicillatus, Panulirus ornatus, Panulirus homarus and Panulirus polyphagus. This species according with lobster species live in Indonesia.

According with the results of Wirosaputro's research (1996) [11], in Gunung Kidul, Yogyakarta, from 3,755 barong shrimps (lobster), there were six kinds of species, namely: Panulirus penicillatus, Panulirus homarus, Panulirus longipes, Panulirus ornatus, Panulirus versicolor, and Panulirus polyphagus.

Lobsters can be classified bellow [12]:
Filum : Arthropoda
Subfilum : Crustacea
Kelas : Malacostraca
Bangsa : Decaphoda
Suku : Palinuridae
Genus : Panulirus
Species : *P. versicolor*, *P. longipes*, *P. ortunus*, *P. homarus*, *P. penicillatus*, *P. polyphagus*

3.1.2 *Species composition of lobster catch based on difference fishing ground*
The composition of lobster catches by treatment with different of fishing ground, fishing ground A and B. Lobster caught during the research from both fishing ground consists of 6 species, namely Panulirus versicolor (bamboo lobster), *P. longipes* (batik lobster), *P. penicillatus* (rock lobster), *P. ornatus* (pearl lobster), *P. polyphagus* (pakistan lobster) and *P. homarus* (sand lobster). The composition of the catch species based on two different fishing ground and the catch that dominates can be seen in the following graphic image.

![Graph composition of lobster species from the sea far from the cliff (A) and cliff of strong reef crest (B)](image)

**Figure 1.** Species of Lobster landed at Tamperan Coastal Fishing Port, Pacitan (Source: Field Data 2019)

**Figure 2.** Graph composition of lobster species from the sea far from the cliff *Fishing ground* (A) and cliff of strong reef crest *Fishing ground* (B) (Source: Field Data, 2019)
In the fishing ground A dominated by 301 of *P. homarus* (63%) from 479 total of lobster. Then was followed by 73 of *P. penicillatus* (15%), then 52 of *P. versicolor* (11%), 33 of *P. longipes* (7%), 19 of *P. ornatus* (4%) and the last there was *P. polyphagus* with only one tail (0.001%). The number of lobster catches from fishing ground B is 292 less than fishing ground A. Only 3 species of lobster are found, dominated by *P. penicillatus* with 202 tail (69%), then 88 of *P. homarus* (30%) and last is *P. longipes* get only 2 tail (1%), research from February - March 2019.

From the results of species composition shows that fishing ground has affects to the species of catch. Several types of lobsters can be known to inhabit areas with rocky substrates such as rock lobsters and some to inhabit areas with sandy mud substrates such as sand, bamboo and pearl lobsters.

From the results of [13], was done in the coastal of Lombok Island, some species of spiny lobster found in coral reef habitats are *P. penicillatus* and *P. longipes*. At station 2 these two species were found concurrently, but at station 1 *P. penicillatus* was found with *P. versicolor*. The opposite happened at station 4, *P. longipes* was found with *P. versicolor*. It is known that these three species do not live in colonies, so it is possible to mingle with the other species. Meanwhile *P. homarus* and *P. ornatus* difference from the four lobster species was described in the last, this species of lobster prefer to choose of sandy coral habitats with seaweed grow. The located of the habitat at station 1, they are found not far from the mouth of river which is always flowing so that the surrounding water becomes more turbid.

### 3.1.3 Distribution of carapace length and weight of lobster

Total of spiny lobster was catched are 682 from 6 species that available. The carapace length have been grouped from the shortest to the longest carapace size.

![Graph of the Distribution of Carapace Length of Lobster landed at Tamperan Coastal Fishing Port (February March 2019). (Source: Field Data, 2019).](image)

Judging from the regulation of carapace length <80 mm (8 cm), there are 395 of spiny lobster (58%) from the total of sample 682, dominated by *P. homarus*. Meanwhile, the spiny lobster with > 80 mm (8 cm) of carapace length, there are 287 (42%). It can be interpreted that most of spiny lobsters landed at Tamperan Coastal Fishing Port in Pacitan are majority have carapace lengths still less than 80 mm (8 cm).
Figure 4. Distribution weight of spiny lobster landed at Tamperan Coastal Fishing Port (February-March 2019) (Source: Field Data, 2019)

Spiny lobster landed at Tamperan Coastal Fishing Port majority have <200 g of weight. It cause the number the lobster <200 g of weight are 420 (61%) and >200 g of weight are 262 individuals (39%). The measurement results of distribution carapace length and weight of lobster based on each species ranging from Panulirus versicolor, Panulirus longipes, Panulirus ornatus, Panulirus polyphagus and Panulirus homarus the majority have carapace lengths below 80 mm (<8 cm) and below 200 grams (<200 grams). Only one type of lobster that meets the criteria is allowed to be caught, namely rock lobster (Panulirus penicillatus) because the majority of those caught have carapace lengths above 80 mm (> 8 cm). Majority the weight of lobster landed at Tamperan Coastal Fishing Port is above 200 grams (> 200 grams). Panulirus polyphagus found only one tail, have 85 mm in length and 205 gram in weight it suitable with the criteria allow to be caught because of > 80 mm in length and > 200 gram in weight.

From any observed [14] the species of lobster fishermen caught in the coastal of Palabuhan ratu are Panulirus ornatus, black spiny lobster/ Panulirus penicillatus rock lobsters, Panulirus versicolor bamboo lobster and Panulirus homarus. The majority of lobster caught is a type of green sand lobster then pearl lobster and followed by bamboo lobster and black lobster. The majority of lobsters weigh less than 300 grams and carapace length is less than 8 cm. The diversity of lobsters in Palabuhan ratu based on the existing regulations for all types of lobster is the majority is not feasible to catch.

3.1.4 Distribution of sex and berried condition when caught

During observations in the field lobster sand occupied the highest value of the other species.

Data from the research showed that there were 311 male lobsters (46%) while there were 371 male females (54%), which were the female lobster more than male, but the difference was not too far apart. When compared with the results of research conducted by Khikmawati [9], that the number of male lobsters for P. homarus, P. versicolor and P. ornatus is more than female while lobster black the number of female is higher than male.

Some results of the research [15], showed that P. gracilis grows faster than P. inflatus, large individuals have lower growth rates than small individuals, but the growth of both species is highly variable and is influenced by environmental factors such as places stay and season. However, further research is needed on this subject. The similarity of growth patterns in several waters, both of the same types are influenced by the environmental conditions of the waters, especially the temperature and availability of food quality in relatively similar waters.
Table 1. Number of Lobster in berried conditions with the average of carapace length and weight

| Species       | Average of Carapace Length | Average of Weight | Total | Percentage (%) |
|---------------|----------------------------|-------------------|-------|----------------|
| P. homarus    | 0                          | 0                 | 0     | 0%             |
| P. penicillatus | 71                        | 158               | 11    | 2%             |
| P. longipes   | 80                        | 221               | 15    | 2%             |
| P. ornatus    | 0                          | 0                 | 0     | 0%             |
| P. polyphagus | 0                          | 220               | 55    | 8%             |

Value 81 12%

During the research, 3 types of lobsters in the nesting condition were also caught. In (table 1), the total number is 81 lobster berried eggs (12%) was found. From the 81 tails, P. longipes have an average carapace length of 71 mm (<80) mm and an average weight of 158 grams (<200) grams with a total of 11 tails (2% of the total 682 tails). P. penicillatus has an average carapace length of 80 mm (> 80 mm) and an average weight of 221 g (> 200 g) with a total of 15 individuals (2% of 682 individuals) and P. homarus have an average carapace length of 81 mm (> 80 mm) and 220 grams (> 200) grams with a total of 55 tails (8% of 682 tail). So it P. longipes that does not meet the 3 criteria was listed on Ministerial Decree of Marine Affair and Fisheries or PERMEN KP (in indonesia language) Number 56 of 2016.

Some results of the research states that November-March is the best lobster catching season, this is because the period is the beginning of the blowing of the west monsoon and with the fall of the rainy season. Famine season occurs in June-October, this is because in that period with the dry season [16]. Based on lobster fishing ground, the fishing season starts from the west and shifts towards the east due to the rainy season coinciding with the west season causing sea water to move eastward. Reduced catches of dry lobster due to deeper water conditions become more stable and ideal for spawning conditions. This is due to the time of spawning is closely related to temperature. Lobsters tend to move into deeper waters (37–55m) to spawn [17].

3.1.5 Statistical inductive analysis

Inductive analysis to applicated of hypotheses with test data statistically. Chi Square, One Way Anova and Continuous Real Difference Tests (BNJ) have been conducted to determine the composition of lobster catches using 2 different fishing ground treatments (fishing ground A and fishing ground B) simultaneously, then to find out the lobster caught in each fishing ground has the same species or different.

3.1.5.1 Chi- Square

Chi-Square test was used to determine the assumption of the zero hypothesis (H0) with hypothesis 1 (H1) of the lobster catch composition from different fishing ground. Also applied to determine the value of observation in accordance with the expected value (expected) and the opposite, so can be used to make conclusions by comparing the calculated X value with X table in the Chi-square table. For the Chi-square calculation results can be seen in the following table:
The observed and expected data (table 2) were calculated using the Chi square formula, the results of the calculated Chi-Square value (X value) showed the number 245.70. Chi Square table value (X table) obtained from the significant level of 95% (df = 0.05) is 5.0 which in the Chi-Square table shows the number 11.07. Decision making from the Chi-Square Test, below:

a. X value < X table, so accept H0/reject H1
b. X value > X table, so reject H0/accept H1.

The number of X value > X table, then reject H0 which means the composition of lobster catches on different fishing ground A and B landed at Tamperan is different.

3.1.5.2 One-Way ANOVA
To conduct the One Way Anova test, it is necessary to have data that meets the requirements for sampling must be from an independent group, normally distributed and homogeneous.

a. One Way Anova Test on fishing ground A
One Way Anova Test produces a calculated F value of 47,063, the significance value (sig) produced is 0.000 < 0.05, which means rejecting H0 accept H1, then performed using the BNJ (Honestly Significant Difference) test, to find out the average lobster composition count on fishing ground A. For the results can be seen in the following table:

### Table 3. Hasil Uji Tukey HSD

| Species | N   | Subset for alpha = 0.05 |
|---------|-----|------------------------|
|         |     | 1   | 2      | 3      | 4      |
| 5       | 15  | .0667  |       |        |        |
| 4       | 15  | .8683  | .8683  |        |        |
| 2       | 15  | 1.2538 | 1.2538 |        |        |
| 1       | 15  | 1.4898 | 1.4898 |        |        |
| 3       | 15  | 1.9306 |        |        |        |
|         | 15  |        |        | 4.1432 |        |
| Sig.    |     | .066  | .260  | .179   | 1.000  |
Based on the Tukey HSD test (table 3), it is found that the significance value is above 0.05 for each type of lobster. In the 4th subset column, sand lobster with an average value of 4.1432. While the average valued at 1.9306 is in the third subset, 1.4898 P. versicolor is in subsets 2 and 3, P. longipes valued at 1.253 is in the second and third subsets, P. ornatus has value 0.8683 in the subset to 1 and 2, while $P$. polyphagus has the lowest value, 0.667 in subset 1.

b. One Way Anova test on Fishing Ground B
Lobster caught at Fishing Ground B only found 3 species, they are Panulirus longipes, Panulirus penicillatus and Panulirus homarus, while other types of catches were zero (not found). The One Way Anova test listed (table 5) produces a calculated F value of 51.845 and the significance value (sig) is 0.000. When viewed from the significance value then compared with an alpha value of 0.05. Sig value The result is 0.000 <0.05, which means reject H0 accept H1, because reject H0 / accept H1 then another test is carried out using the BNJ (Honestly Significant Difference) test, to determine the average lobster composition count on fishing ground B.

Table 4. Hasil Uji Tukey HSD Fishing Ground B

| Spesies          | N   | Subset for alpha = 0.05 |
|------------------|-----|------------------------|
|                  |     | 1          | 2          | 3          |
| 2                | 16  | 0.0884     |             |             |
| 5                | 16  | 2.1825     |             |             |
| 3                | 16  | 3.3356     |             |             |
| Sig.             |     | 1.000      | 1.000      | 1.000      |

Based on the Tukey HSD test (table 4), it is found that the significance value is above 0.05 as a whole the result of difference in relationship between each type of lobster. The third subset column shows that $P$. penicillatus produces an average value of 3.3356, for $P$. homarus in the second subset column has an average value 2.1825 and $P$. versicolor is the subset 1 column with an average value of 0.884.

Results, that $P$. penicillatus has a habit of living in shallow waters and living outside of coral reefs. $P$. homarus has a habit of living in shallow deep sand up to a few meters and lives near rock pits. $P$. longipes inhabit a sheltered place, living in rock or coral pits at night they climb into the coral reefs to look for food. ornatus inhabit coral reefs in rather shallow and slightly turbid waters, in general they do not want to be caught in a trap. $P$ versicolor inhabits coral reefs in waters with a depth of several meters, lives in a sheltered place between the rocks and is rarely grouped and does not want to be caught in a trap. $P$. polyphagus is the smallest number of other species. These lobsters inhabit murky waters and often live on a muddy, rather deep sea floor [11].

4. Conclusion
From 9 species of lobster in the world include of genus Panulirus there are 6 types of lobsters in the south of Pacitan namely $P$. versicolor, $P$. longipes, $P$. penicillatus, $P$. ornatus, $P$. polyphagus, and $P$. homarus. Species composition of each fishing ground shows differences, found 6 types of lobsters on sea fishing ground (A) and only 3 species on the cliff strong reef crast fishing ground ($P$. longipes, $P$. penicillatus and $P$. homarus). Based on the results of measurements carapace length, weight and berried conditions it can be said that under in regulation, becaus the carapace length is 58% <8 cm, 62% <200 gram and 12% in berried conditions.
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