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Research Article

FISHERIES RESOURCE STATUS OF SPINY LOBSTER *PANULIRUS PENICILLATUS* IN LABANGKA WATERS, SOUTH SUMBAWA, INDONESIA

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ABSTRACT

Labangka waters in the south Sumbawa are potential fishing areas only for pronghorn spiny lobster *(Panuliruspenicillatus)*. The aim is to reveal lobster fisheries management activities. Compilation and analysis data of biological dimensions (lobster) and technological dimension (gillnet) is carried out in Labangka, Sumbawa Regency, during May 15-10 July 2019. Lobster production in 2018 describes the utilization status of 'Lightly Exploited' (44.13%). Analysis of 293 samples of pronghorn spiny lobster showed hypo-allometrc growth patterns. The condition factor of female lobster is greater than male, and tends to decrease along with increasing carapace length/CL (age).The highest CL in the class 60.0-75.0 mm which reached 61.09%, and body weight (BW) dominant in the class 200-300 g as many as 44.03%.Gillnet to catch lobsters is selective, effective and environmentally friendly. This is indicated by the size of lobster worthy of capture (BW>200 g/ind) totaling 74.40% at CL>63 mm/ind.

INTRODUCTION

The largest production of marine fisheries in Nusa Tenggara Barat Province (NTB) is contributed by fishing in the coastal waters of Sumbawa Island, which is a habitat for coral reef resources covering 37,104.00 hectares (MAF NTB, 2016). In 2016, Sumbawa fishermen contributed 62.33% lobster production, and 53.20% of them were sand lobster *(Panulirushomarus)*. There are no specific data regarding the production of pronghorn spiny lobster *(P. penicillatus)* from Sumbawa.

Pronghorn spiny lobster type is one of the 5 types of lobster in the Sumbawa reef waters. The other four types are pearls *(P. ornatus)*, pakistan*(P. poliphagus)*, batik *(P. longipes)*, sand *(P. homarus)*, and bamboo *(P. versicolor)*. Live lobster fisheries resources are spread on coral reef ecosystems in southern Sumbawa waters which are part of the Indian Ocean.

Sumbawa is known in NTB as a producer of pronghorn spiny lobster. One of the lobster fishing ground is in the waters of south Sumbawa, precisely in tidal waters of Labangka District, Sumbawa Regency. While the lobster fishing center in Labangka is Jaya Makmur Village and Labangka Village.

Lobster fisheries management in Labangka consists of technological dimensions (fishing) and economic dimensions (trading) carried out throughout the year. Lobster caught by fishermen is sold to collector traders in Jaya Makmur Village and Labangka Village. The results of lobster sales are used as a source of daily income to support the households of Labangka coastal communities.

This research is the first study conducted to determine the management of pronghorn spiny lobster fisheries in Labangka. The aim is to reveal the pronghorn spiny lobster fisheries management activities. This paper provides a record of the new distribution of pronghorn spiny lobster species in Indonesian coastal waters and their management status.

The authors visited the location of research in Cemplung beach (Jaya Makmur Village, Labangka District) 8 times, during the period of May 15 to July 10, 2019. This location was the center of lobster landing and its sale by fishermen to collecting traders.

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MATERIALS AND METHODS

Location and Duration of Study

Pronghorn spiny lobster samples were collected from Labangka, Sumbawa Regency, as many as 293 individuals during 15 May-06 July 2019. All samples came from fishermen who sold their lobsters to collectors at Cemplung Beach, Jaya Makmur Village (Figure 1).

Figure 1 A map of research location in Labangka

Measurements of carapace length (CL) and weighing body weight (BW) for each individual sample were carried out at the lobster collectors' place. The equipment used consist of digital caliper, digital scales, digital cameras, and digital recorders, as well as stationery. One sample individual is shown in Figure 2.

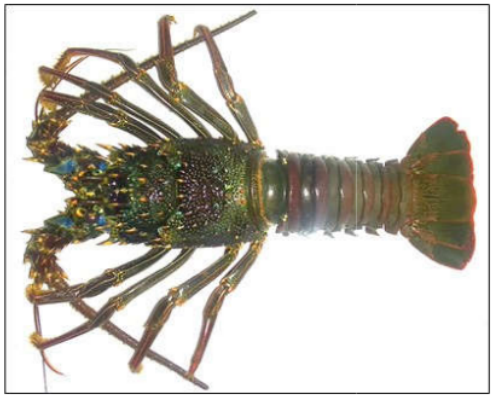

Figure 2 *P.penicillatus* (female) from Labangka waters

Methods

The method of this research is survey-dependent-descriptive method, which is the collection of data and samples depending on other parties, in this case fishermen and collectors. The data collection techniques consist of measurement, weighing, observation, dialogue, and documentation of lobster samples. Lobster measured and weighed are all lobsters that fishermen sell to collectors. Data collected is quantitative data which is divided into biological dimensions (lobster) and technological dimensions (gillnet).

Data processing is done quantitatively to determine lobster stock/reserve status and its growth. The results of data processing were used to estimate the potential sustainable yield status (Y_{MSY}) of lobster resources in the waters, length & weight relationship patterns (LWR), condition factors (K), and growth pattern (b). The results of data processing are also used to estimate the level of productivity, effectiveness, and selectivity of gillnet.

RESULTS

Sustainable Yield

To estimate the sustainable potential of pronghorn spiny lobster resources using secondary data. The intended data consists of lobster production (kg) and gillnet total (unit) for 5 years (2014-2018). The data is sourced from the purchase records of pronghorn spiny lobsters belonging to fish traders who live in Labangka Village and Jaya Makmur Village (Table 1).

Table 1 Production of *P.penicillatus* from Labangka

Year	Fishing Gear (unit)	Production (kg)	CpUE (kg/ unit/year)
2014	190.00	1645.99	8.66
2015	102.00	3135.80	30.74
2016	186.00	1163.56	6.26
2017	167.00	1797.11	10.76
2018	139.50	1163.56	8.34

Source: Jumadi & Rudy, 2019 (pers. com.)

The calculation uses a surplus production model approach, based on the equilibrium state model approach developed by Schaefer (1954) and Fox (1970). The estimate for resource utilization level of pronghorn spiny lobster is a percentage of the comparison between production in 2018 and sustainable potential (Y_{MSY}). The equation is $(Y_t/Y_{MSY})\ x\ 100\%$, where Y_t is the total production of pronghorn spiny lobster in 2018 ($Y_t = Y_{2018}$).

The results of data processing get an estimated value of sustainable potential (Y_{MSY}) is 2,636.46 kg / year, the maximum number of gillnet (f_{MSY}) is 106-107 units / year, and gillnet maximum productivity (U_{MSY}) = 24.85 kg / unit / year. Meanwhile, estimates of lobster resource reserves in Labangka waters is 5,272.92 kg / year. Thus, the resource utilization rate is 44.13%, or its utilization status is 'Lightly Exploited' (25-50%). If using the standard allowable catch amount (80% MSY), the utilization rate is 55.17%, or the utilization status is "Moderately Exploited" (50-75%).

LWR and Growth Pattern

Length and weight (LWR) analysis of lobster resource using data on carapace length (CL) and body weight (BW). Because lobsters are living things that live in the wild and must die, then the data is converted or transformed into natural logarithms (ln) form before being processed using a simple regression method. The lobster LWR analysis gets the CL coefficient value which is the growth pattern value (b).

Simple regression method shows 'statistical regression' values for the feasibility analysis of the model. The results are as follows: (a) correlation value (r) = 90.64%: the relationship between CL and BW is very close, (b) value of determination

(R^2) = 82.15%: the influence of CL is very strong against BW, and the built model can be used to forecasting (R^2> 60.00%), (c) Adjusted R Square = 82.09%: the sample has a very high ability to find answers in its population, and (d) errortolerable (Standard Error) = 16.54%: model deviation can be accepted / tolerated because it is less than 25.0%.

The results of data processing on 293 individual pronghorn spiny lobster obtained the LWR equation as follows: $ln\,WB = -4.24 + 2.31\,ln\,CL$. The model means the addition of 1 CL unit will increase BW as much as the coefficient value of CL, or CL has a positive influence on BW.

Referring to the LWR equation, obtained the growth rate indicated by the coefficient of ln CL = 2.31. This value shows the growth pattern of pronghorn spiny lobster with hypo-allometric status. This status shows the accretion rate of CL is faster than the growth rate of BW. Thus the lobster's body shape is thin / slim.

Condition Factor

The condition factor (K) is used to estimate fish are in a condition that is feasible to be caught, eligible for sale, and feasible for processing. K is the ratio of BW and cube of CL to the formula $K = 100\,WT/CL^3$, description: K = condition factors, BW = body weight (gram), CL = carapace length (mm).

The lobster K value of Labangka is 0.080. Male lobster has the highest K = 0.110, lowest K = 0.034, and K average = 0.079. Whereas female lobsters, the highest, lowest, and average K values were 0.127, 0.032, and 0.085 respectively. The K value is higher in lobsters captured during June and July than captured in May. Overall, the female lobster K value is higher than that of males (Table 2, Table 3, Figure 3).

Table 2 K value of *P.penicillatus* based on sex

Description	Sex		
	Male+Female	Male	Female
Average	0.082	0.079	0.085
Highest	0.111	0.108	0.127
Lowest	0.032	0.034	0.032

Table 3 K value of *P.penicillatus* based on month

Description	Month		
	May	June	July
Male+Female	0.069	0.081	0.082
Male	0.065	0.082	0.080
Female	0.077	0.084	0.083

Environmentally Friendly

Labangka fishermen catch lobsters using gillnet with mesh size of 4.5 inches, net height = 0.50-1.5 m, and net length = 112-168 m. Lobster fishing operations are carried out every day except in bad weather, storms and sea tide conditions. It began by setting gillnet when sea water recedes on the bottom of the waters of the rocks and sand near the beach. Gillnet is stretched to form a semicircular area facing the beach, and both ends are near the beach. Gillnet was left installed during the tidal sea period until the sea water receded. The semicircular position aims to trap the lobster. While the gillnet stretch aims to hold the lobster out of the gillnet installation area.

When the sea recedes, lobsters are found in the semicircular area near the gillnet, and other lobsters that are stuck in the mesh of gillnet. Lobster fishing operations end after fishermen collect trapped lobsters, and fold gillnet. Gillnet is washed and re-prepared to catch lobster tomorrow.

The operation of gillnet to capture lobsters in rocky and sandy waters does not damage the coral reef ecosystem, so it is environmentally friendly.

Effectivity and Selectivity

Gillnet traps lobsters and finally lobsters get stuck on gillnet body so that the lobster is unable to escape. Then the gillnet becomes a fishing gear that has a high effectiveness against the ratio of trapped lobsters.

The selectivity of fishing gear can be measured by body size, age, and type of fish caught (Troadec, 1992). The selectivity standard of lobster fishing gear is the size of *Panulirus* spp. i.e. the size of CL is more than 8 cm or BW exceeds 200 g / ind (MAFM, 2015; MAFM, 2016).Pronghorn spiny lobster undergoes first gonad maturity (gonad maturity level/GML III, IV, V) at CL 57-67 mm and BW 130-180 g (Junaidi *et al*., 2010). In this study, to predict the selectivity of lobster fishing gear is usedBW> 200.00 g / ind. Thus, the selectivity standard divided into 5 categories, namely: (a) Not Selective/NS = 0-25%, (b) Less Selective/LS =>25-50%, (c) Quite Selective/QS =>50-75%, (d) Selective/S =>75-<100%, and (e) Very Selective/VF = 100%.

Lobsters from the Labangka were transported to Lombok Island using land transportation modes. Permission to transport lobster from Labangka is issued based on a BW more than 200 g / ind (pers.com. Jumadi& Rudi Hartono, 2019). Female lobsters from Labangka that reach BW more than 200 g / ind have a CL 63.00 mm (6.30 cm)(Table 4). At the CL there is no BW found less than 200 g / ind. Based on the regulation for granting lobster transport, the caught lobster ratio (BW> 200 g) is 74.40% (Table 5). Thus, the gillnet lobster selectivity status is classified as 'Quite Sustainable' (> 50-75%).

Table 4 The CL class of *P.penicillatus*

No.	Length Class	Total Samples (ind)	Total Length (cm)	ACL (cm/ind)	Ratio %
1	<50	3	143	47.74	1.02
2	50-<55	18	978	54.36	6.14
3	55-<60	25	1,439	57.56	8.53
4	60-<65	71	4,459	62.81	24.23
5	65-<70	58	3,920	67.58	19.80
6	70-<75	50	3,623	72.45	17.06
7	75-<80	25	1,939	77.57	8.53
8	80-<85	16	1,325	82.84	5.46
9	85-<90	10	874	87.44	3.41
10	90-<95	9	826	91.81	3.07
11	95-<100	3	297	98.96	1.02
12	≥100	5	542	108.36	1.71
	Total	293	20,366	69.51	100.00

Table 5 The BW class of *P.penicillatus*

No.	Weight Class	Total Samples (ind.)	Total Weight (g)	ABW (g/ind)	Ratio (%)
1	< 100	2	173.00	86.50	0.683
2	100-<150	20	2,593.00	129.65	6.826
3	150-<200	53	9,557.00	180.32	18.089
4	200-<250	66	14,744.00	223.39	22.526
5	250-<300	63	17,536.00	278.35	21.502
6	300-<350	29	9,071.00	312.79	9.898
7	350-<400	21	7,856.00	374.10	7.167
8	400-<450	12	5,082.00	423.50	4.096
9	450-<500	5	2,353.00	470.60	1.706
10	500-<550	14	6,757.00	482.64	4.778
11	550-<600	2	1,132.00	566.00	0.683
12	≥600	6	3,812.00	635.33	1.706
Total		293	80,666.00	275.31	100.00

DISCUSSION

P. penicillatus lives in waters with a depth of 1-4 m and is often found in rocky waters (Fauzi*et al.*, 2013). This type of lobster is solitary and nocturnal, often found in the bottom of waters near the coast and small islands, and utilizing coral reefs to hide during the day (Holthuis, 1991).

The results of identification of 315 individual lobsters caught by fishermen in Labangka, dominated by pronghorn spiny lobster(293 individuals or 93.02%). The remaining 6.98% is a type of sand lobster *(P. homarus)* that lives on sandy waters around rocks near the coast.

Bathymetric of coastal waters along Labangka which is used as fishing ground of pronghorn spiny lobster are quite gentle, consisting of coral, sand, and seagrass. So that the waters along the coast of Labangka are suitable for habitat and precisely as a fishing ground pronghorn spiny lobster.

Overall, the average BW is 276.44 grams and the average CL is 69.51 mm. Male lobsters amounted to 139 individuals (47.44%) with an average BW of 278.61 g / ind and an average of CL 70.60 mm / ind. Whereas female lobsters amounted to 154 individuals (52.56%), BW averaged 274.47 g / ind and the average CL 68.52 mm / ind. Lobster caught and sold by Labangka fishermen for BW below 200 g / ind is 25.60%.50% of the pronghorn spiny lobster samples from Ekas Bay experienced the first gonad ripening (GML III) at CL 51-61 mm and BW 100-150 g, (Junaidi *et al.*, 2010). The development of gonads is the growth of each egg, namely increasing the diameter and weight of the eggs which indicate GML. When the study took place (May-July) found lobsters has gonad mature. Morphological observations of eggs indicate lobster has reached GML IV. This is in line with the opinion of Junaidi et al. (2010) which states that the maturity period of gonads in male lobsters occurs during the June-September, and the females along June-November.

Growth can be defined as the occurrence of changes in the size of length and weight in a certain time span of each living creature, including lobsters. These changes can occur together or individually, and can increase or decrease. When the increase in length and weight increases, it is called 'positive growth', and if it happens otherwise it is called 'negative growth'. For fisheries management what is needed is positive growth which results in an increase in biomass in a population. Effendie (2002) explains that the growth of individual fish follows an autocatalytic pattern forming a sigmoid growth curve (S).

Based on the results of the LWR analysis, it is known that the CL and BW variables have a very close relationship (r), and the CL variable is very strong in determining the BW variable. The value of determination (R^2) is more than 60% as an indication that the model formed can be used for forecasting.All status parameters are 'regression statistics' for the pronghorn spiny lobster in the Labangka waters similar with the pronghorn spiny lobster in Aceh Barat waters (Suman and Subani, 1993), Pangandaran waters (Sumanet *al.*, 1994), and coastal waters of GunungKidul and Pacitan (Fauzi*et al.*, 2013).

LWR analysis uses simple regression method (Table 5) on CL and BW data as a whole, female, and male, resulting in similarities in the LWR pattern which follows the equation $\ln W = -a + b \ln L$`. The growth pattern (b) is also the same namely hypo-allometric (b = 2.21-2.48) which means that the weight growth rate is slower than the long growth rate. The research results of the pronghorn spiny lobster study in the Indian Ocean obtained the same growth pattern that is negative allometric (Suman and Subani, 1993; Suman *et al.*,1994; Fauzi *et al.*, 2013).

The condition factor (K) can be used as a measure to estimate the condition of the aquatic environment based on the standard of the physical condition of individual fish by comparing the weight with its length. Condition factors have been used to: (a) predict better fish conditions based on weight and length (Bagenal and Tesch, 1978),(b) disturbance index of growth and intensity of feeding (Fagade, 1979), (c) knowing the condition of fish associated with length changes (Bakare, 1970; Fagade, 1979),(d) estimating the reproductive cycle of fish (Welcomme, 1979; Effendie, 2002), and explaining the size of fish (Effendie, 2002). Thus, if K are of low value, it can be assumed that: (a) the aquatic environment is bad, (b) does not support the growth of individual fish, or (c) is unable to provide for the necessities of life and the life of fish. Condition factors can be used as a basis for determining the feasibility of fish to be captured, harvested, sold, and / or processed.

Factor conditions are caused by various influences, including food, age, gender, gonadal maturity, and fish body size (Effendie, 2002). In Figure 3, it can be seen that the addition of fish age, which is indicated by the addition of CL as a function of age, tends to have a smaller K value. This result is identical to the condition of the pronghorn prickly lobster factor studied by Fauzi et al. (2003) in the coastal waters of GunungKidul (Yogyakarta) and Pacitan (JawaTimur). This condition means that gonadal mature lobsters (GML IV) are quite widely available in Labangka waters. The safety of the parent lobster stock is due to the lack of gillnet operating days which are actually classified as productive fishing gear.

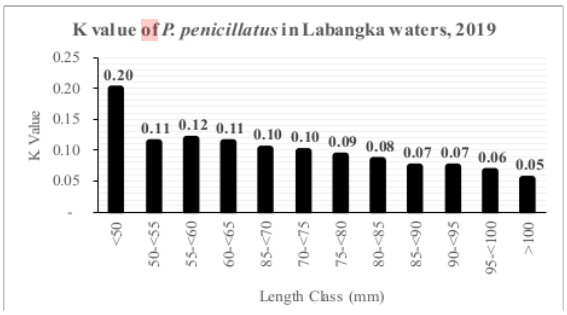

Figure 3 K value of *P. penicillatus* from Labangka, 2019

In connection with the selectivity of lobster fishing gear, those responsible for selecting the size of transportable lobsters are fishermen and collectors, not mere nets. When fishermen find out the lobster is caught below the standard length size (CL <63 mm), the fisherman must release it back into the waters. When fishermen sell lobsters below the standard (BW<200 g), the collector refuses to buy the lobster.

CONCLUSION

The resources of P. *penicillatus* or 'lobster batu' (Indonesian) in Labangka waters have become fisheries resources that are utilized and traded as a source of family income. Its existence every month indicates that Labangka has clear, clean, unpolluted and fertile waters to meet the needs of life and the life of lobster resources and populations. The technology for the utilization of lobster fisheries resources that has been implemented, so far has provided safety in the reserves of lobster resources and population. Stock of pronghorn spiny lobster parents are still enough to support responsible lobster fisheries management. CpUE lobster fisheries show good gillnet performance. For this reason, fishing gear that is effective, selective, productive, and efficient in catching lobsters transportable in Labangka waters is needed. Pronghorn spiny lobster that is worthy of transport is BW more than 200 g / ind which is equivalent to CL 63.00 mm / ind (6.30 cm / ind).

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