

CATCH COMPOSITION AND CATCHABLE SIZE OF LOBSTERS (*Panulirus spp*) IN LEBAK BANTEN WATERS, INDONESIA

Komposisi Hasil Tangkapan dan Ukuran Layak Tangkap Lobster (Panulirus Spp.) di Perairan Lebak Banten, Indonesia

Ndaru Nalurita Sani¹, Ari Purbayanto², Ronny Irawan Wahju^{2*}

¹Program Studi Teknologi Perikanan Laut, Fakultas Perikanan dan Ilmu Kelautan Institut Pertanian Bogor, Jl. Agatis Kampus Dramaga Bogor, West Java, Indonesia 16680. ndaru_nalurita@apps.ipb.ac.id

²Departemen Pemanfaatan Sumberdaya Perikanan, Fakultas Perikanan dan Ilmu Kelautan Institut Pertanian Bogor, Jl. Agatis Kampus Dramaga Bogor, West java, Indonesia 16680. purbayanto@apps.ipb.ac.id, ronnywa@apps.ipb.ac.id

*Correspondence: ronnywa@apps.ipb.ac.id

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ABSTRACT

Information on the catch composition and catchable size of lobsters in Lebak waters remains limited, posing challenges for effective fisheries management. This study aims to assess the technical performance of the lobster fishery and analyse catch composition. Data on technical performance were collected through interviews with fishers and lobster collectors using random sampling, while a census approach was applied to measure carapace length and weight for 589 lobsters. A descriptive quantitative analysis was conducted to evaluate the length-weight relationship of lobsters. The findings indicate that fishers predominantly use polyamide monofilament gillnets with a mesh size of 3.5–4.0 inches, operating traditional outrigger boats of 2–3 GT and 7 GT for single-day fishing trips in Lebak waters. *Panulirus homarus* was the dominant species in the catch. The sex ratio of lobsters was imbalanced, and their growth pattern exhibited negative allometry ($b < 3$). An assessment of catch sizes against the standards set by PERMEN-KP No. 16/2022 revealed a high proportion of undersized lobsters in the Binuangun Estuary, including *P. penicillatus* (78–83%), *P. homarus* (80–100%), *P. ornatus* (23%), *P. longipes* (90–100%), and *P. versicolor* (65–100%). Similarly, in the Cibareno Estuary, the percentages of undersized lobsters were *P. penicillatus* (84–100%), *P. homarus* (98%), *P. ornatus* (0%), *P. longipes* (100%), and *P. versicolor* (92%). These findings highlight the need for stricter management measures to ensure sustainable lobster fisheries in the region.

Keywords: catchable, Lebak Banten waters, length weight, lobster, sex ratio

ABSTRAK

Informasi komposisi hasil tangkapan dan ukuran layak tangkap lobster (*Panulirus spp*) di perairan Lebak masih terbatas, sehingga sulit untuk mendukung pengelolaan perikanan lobster. Penelitian bertujuan mendeskripsikan keragaan teknis perikanan lobster dan komposisi hasil tangkapan. Data keragaan teknis diperoleh dengan wawancara kepada nelayan dan pengepul lobster dengan teknik random sampling dan pengumpulan data lobster sebanyak 589 ekor dengan teknik sensus diukur panjang karapas dan bobot. Penelitian ini menggunakan analisis deskriptif kualitatif, serta analisis hubungan panjang bobot lobster. Hasil penelitian menunjukkan bahwa unit penangkapan lobster menggunakan jaring rampus berbahan dasar polyamide monofilament dengan ukuran mata jaring 3,5-4,0 inci. Nelayan menggunakan perahu kincang dengan ukuran 2-3 GT dan 7 GT dan pengoperasian secara *one day fishing* di perairan Lebak. Hasil tangkapan dominan adalah *Panulirus homarus*. Nisbah kelamin lobster menunjukkan tidak seimbang dengan pola pertumbuhan menunjukkan nilai $b < 3$ yaitu allometrik negatif. Hasil persentase ukuran hasil tangkapan lobster

berdasarkan PERMEN-KP No 16 Tahun 2022 yaitu ukuran lobster yang belum layak tangkap di Muara Binuangeun seperti *P. penicillatus* (78 - 83%), *P. homarus* (80 - 100%), *P. ornatus* (23%), *P. longipes* (90 - 100%), dan *P. versicolor* (65 - 100%) dan Muara Cibareno diantaranya *P. penicillatus* (84 - 100%), *P. homarus* (98%), *P. ornatus* (0%), *P. longipes* (100%), dan *P. versicolor* (92%).

Kata kunci: layak tangkap, lobster, nisbah kelamin, panjang bobot, perairan Lebak Banten

INTRODUCTION

Lobsters are an economically important fishery commodity that is traded for both domestic and global levels. There are 19 species of lobsters known in the world from the genus *Panulirus*, which live in tropical waters with high commercial value (Holthuis 1991; Garibaldi 2012). Types of lobsters that are found in almost all Indonesian waters, including South Kalimantan, include bamboo lobsters, pearl lobsters, and Pakistani lobsters (Anggraini *et al.* 2021). Meanwhile, in the waters of Southern Java, the types of lobster found include rock lobster, sand lobster, pearl lobster, batik lobster, bamboo lobster, and Pakistani lobster (Pratiwi 2018; Setyanto *et al.* 2019; Setyanto and Halimah 2019). Lobsters in the waters of Southern Java are spread from the waters of the Sunda Strait, Binuangeun waters, Palabuhanratu waters, Pangandaran waters, Cilacap waters, Kebumen waters, Gunungkidul waters, to Pacitan waters (Hargiyatno *et al.* 2013; Nurcholis *et al.* 2018; Baskoro *et al.* 2019; Wardiatno *et al.* 2020).

The potential for fisheries resources in Lebak waters, especially lobster fishing, is quite large because the characteristics of the water area are following with the conditions of the lobster habitat. Lobsters are marine biota that live in waters with coral substrates, waves, and high currents (Kusuma *et al.* 2012). The Banten Province Fisheries Statistics Agency reported that lobster production volume in 2019 was 980.40 tons and in 2020 it was 147.80 tons (KKP 2021). This data shows that the amount of lobster production in Banten waters has decreased. This production volume decreased by 832.6 tons (84.9%) from the previous year, although lobsters remain one of the fishery commodities with important economic value for export (Fauzi *et al.* 2013).

The high demand in domestic and global markets and the limited amount of production originating from aquaculture products can result in pressure on lobster fishing in the wild. The lobster population can experience a decline as a result of fishing activities that are carried out continuously without good

management. Apart from that, the decline in lobster stocks in waters is due to fishing in unsustainable numbers and catch sizes (Marsela *et al.* 2022). The lobster population has decreased due to the high economic value of lobsters, so fishermen carry out intensive fishing without paying attention to the impact on the availability of lobster resources (Damora *et al.* 2018). If this is done for a long time, it is feared that it could disrupt the sustainability of lobster stocks, thereby threatening the sustainability of lobster fisheries (Suman *et al.* 2019).

Fishermen have limited understanding regarding lobster fishing, then carry out intensive exploitation of lobster populations (Jefferies 2010), so excessive exploitation, climate change and habitat loss can cause a decline in lobster populations in waters (Kembaren *et al.* 2015; Yellapu *et al.* 2017; Pratiwi 2013). The Lebak Banten Maritime Affairs and Fisheries Service reported that the average lobster production volume in 2019 was 2440 kg and in 2022 it was 621 kg. This data shows that over 4 years, the number of lobster production in Lebak Banten waters has decreased by almost 75%. Utilization of lobster resources in Lebak waters is still experiencing problems, namely based interviews with the government of the Lebak Maritime Affairs and Fisheries Service show that there is still limited information and data regarding the technical performance of lobster fishing, the composition of the catch and decent size to catch lobsters. Meanwhile, information and research related to the technical performance and size of lobsters caught in Lebak waters has been carried out by Alhikmat (1999). Meanwhile, Nurdin *et al.* (2023) provide information on the composition of catches of clear lobster seeds in Lebak waters. This condition can become an obstacle for the government in creating sustainable lobster management policies. Information on the technical performance and composition of lobster catches can be used as a basis for controlling utilization and stages in lobster management (Dowling *et al.* 2015), including population parameters such as the number several species, species diversity, and growth aspects (Zairion *et al.* 2018; Taurusman *et al.*

2020). The problem of lobster fisheries in Lebak waters can be overcome by using a data approach and information on technical fishing performance, fishing areas, and biological parameters including carapace length, lobster weight, and lobster sex. This information is quite important material in managing lobster resources. This research aims are to describe the technical performance of lobster fisheries, analyzing the composition of lobster catches and the size of lobster catch as basic information in sustainable lobster fisheries management.

METHODS

Time and Sampling Sites

Data collection was carried out in Lebak Regency, Banten, which includes Muara Binuangeun Village and Cibareno Village, as can be seen in Figure 1. Data collection was carried out during April 2022.

Collecting and Analysis Data

The data collected to answer the first objective include the main dimensions of the vessel, the type and size of fishing gear, the method of lobster fishing operations, the location of the catch, and lobster production data for 2019-2021 obtained from government agencies of

the Lebak Marine and Fisheries Service. The data was obtained by conducting interviews with fishermen and collectors using random sampling techniques. The number of respondents consisted of 1 collector who had 20 lobster fishermen in Binuangeun, then interviews were conducted with five lobster fishermen. For respondents in Cibareno, one collector who has 30 lobster fishermen is considered to represent the population.

The second objective data includes carapace length, lobster weight, and lobster sex. Data collection of lobsters using the census method. Lobster sampling technique by measuring carapace length, weight, and sex collected by collectors in Binuangeun and Cibareno. Lobsters obtained during the study were 237 lobsters in the Binuangeun Estuary and 352 lobsters in the Cibareno Estuary. Lobster catches were identified using the literature on small-scale fisheries guide to lobster fisheries (Holthuis 1991).

Technical Performance Analysis of Lobster Fisheries

Data on fishing gear, gear operation methods, fishing vessels, fishing grounds, and fishing seasons were processed in qualitative descriptive, fishing ground mapping, and graphical forms. The analysis used for the first objective used qualitative descriptive analysis.

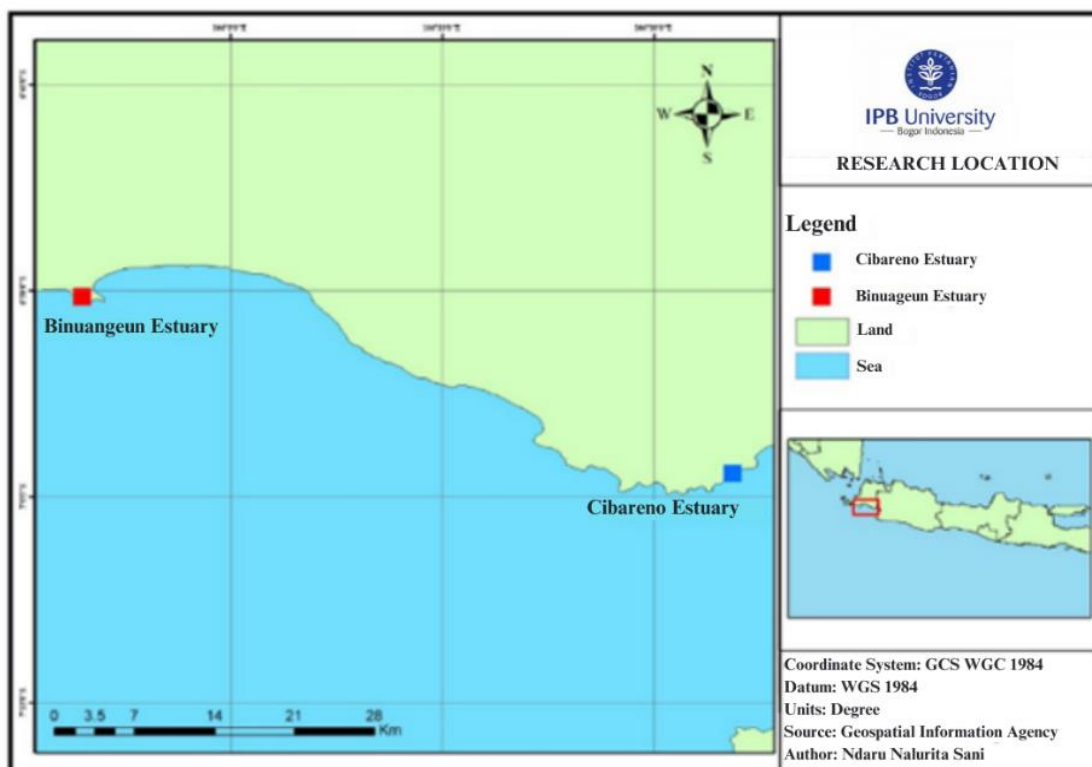


Figure 1 The research location is in the waters of Binuangeun estuary and Cibareno estuary Lebak Banten, Indonesia

Lobster Catch Composition Analysis

Catch composition is represented through graphs and catch tables for all lobster species catches, and carapace length data is represented through tables. Analysis of lobster catch composition using quantitative descriptive. The results of the length-weight relationship analysis are then compared with the reference source CLM and PERMEN-KP No. 16 of 2022. Analysis of the relationship between carapace length and lobster weight uses the equation $W=aL^2$, where W is weight (grams), L is carapace length (mm), a is a constant, and b is an exponential value (Effendi 2002).

RESULT

Technical Performance of Lobster Fisheries

Fishing Gear

The lobster fishing gear used by fishermen in Lebak Banten waters is a lobster net or rampus net or often local fishermen call it a mangkara net (Figure 2). The mangkara net has a rectangular shape that has a mesh

size of 2 - 3 inches with the basic material of Polyamide monofilament. The top of the net is fitted with a float made of PVC, and the bottom is fitted with a lead weight. Fishermen operate the rampus net with a one-day fishing system (daily trip), then setting the net at night and soaking it overnight.

Boats and Fishing Gear

The fishing boats used by Lebak Banten fishermen are motorboats that use old tires equipped with nets as mounts (Figure 3). There are two sizes of motorboats in the area, namely 7 and 2-3 GT made of wood or fiber. Fishermen often call it a minnow boat (Figure 3a). Rampus net boats use outboard motor engines with Yamaha or Suzuki brands with a power of about 15 PK with boat sizes of 9.5-15 meters long, 1.2- 2.5 meters wide, and 1.0-1.4 meters deep.

Lobster fishing aids in the waters of Lebak Banten Regency, especially the Binuangun area, the results of interviews, as many as 80% of fishermen use old tires (Figure 3b). The operation is carried out by 1 fisherman by diving and using fin to facilitate movement in the waters.

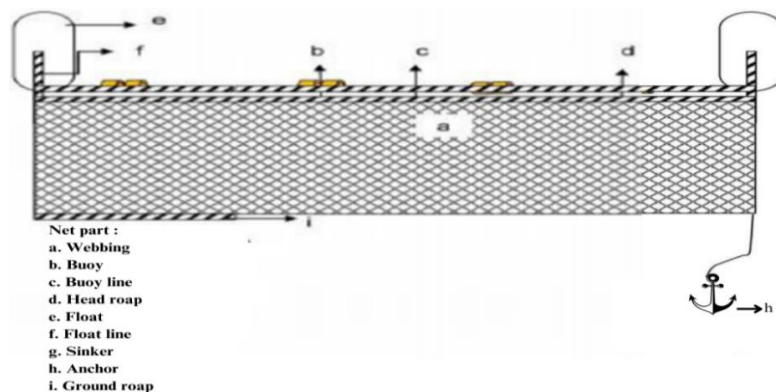


Figure 2 Construction of the mangkara net used by fishermen to catch lobster in Lebak Banten, Indonesia



(a)



(b)

Figure 3 (a) A minnow boat used by fishermen in Lebak Banten, Indonesia, b) Old tires used as lobster fishing aids.

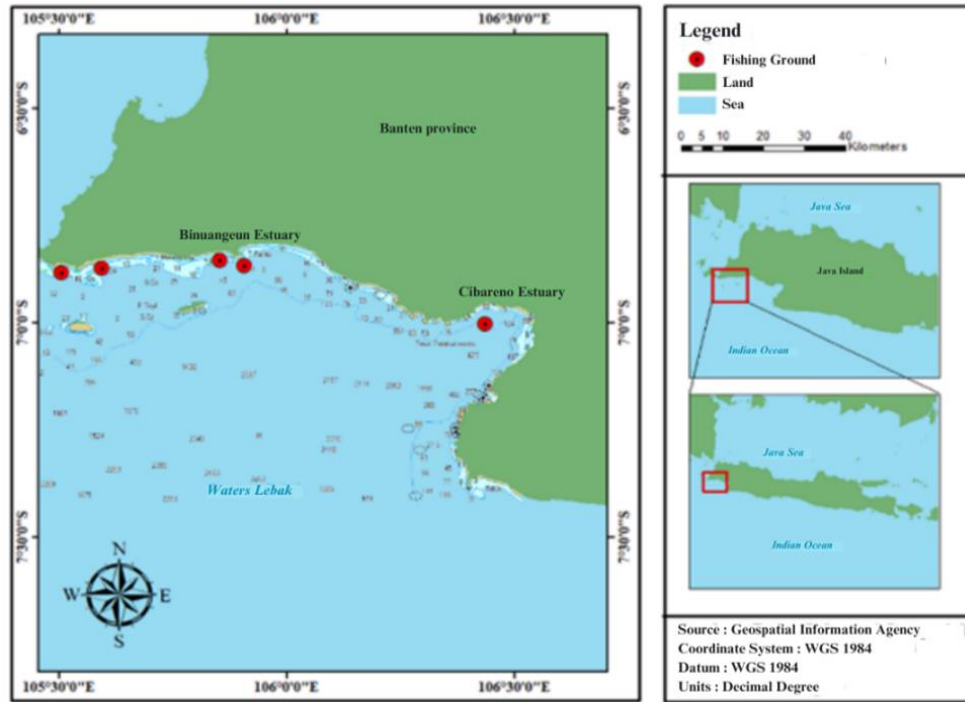


Figure 4 Lobster Fishing Grounds of Lebak Banten Fishermen, Indonesia

Lobsters Fishing Ground

Lobster fishing grounds are spread throughout the waters of Lebak Banten. The results of interviews with fishermen show that lobster catching activities are generally carried out in Binuangeun waters which include Rancecet Beach waters, Mantiung Beach waters, Karang Kembang Rangjang waters, and Bagedur Beach waters (Figure 4). Binuangeun waters are directly connected to the Indian Ocean. These waters are characterized by a depth of 15-40 m with a relatively flat to moderate slope (Kamiludin

and Darlan 2013), then have coral, rock, and sand-silt substrate conditions (Masria 1991).

Lobster Fishing Season

Based on the results of the analysis of production data recorded at DKP Banten in 2020-2022, it shows that for three years lobster production has fluctuated every year. The highest lobster production occurred in 2022, namely in May amounting to 1,155 kg/month, in 2020 in September amounting to 680 kg/month, in 2021 in October amounting to 1,127 kg/month.

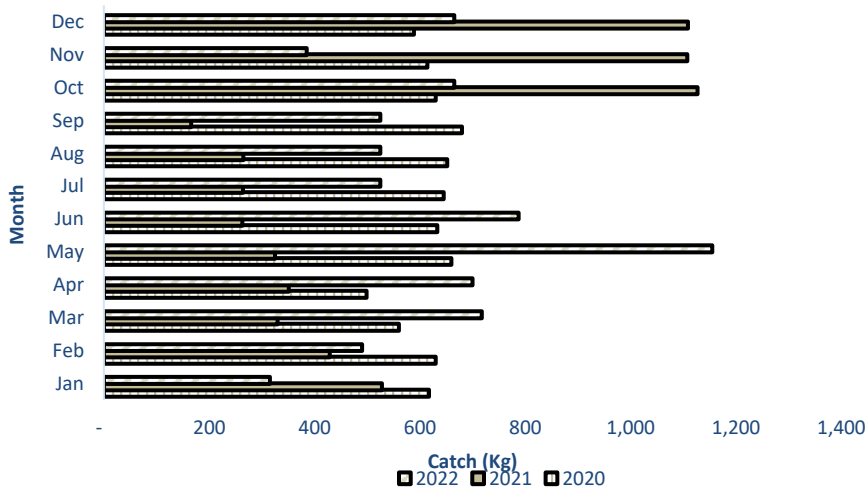


Figure 5 Lobster fishing season based on lobster catch data

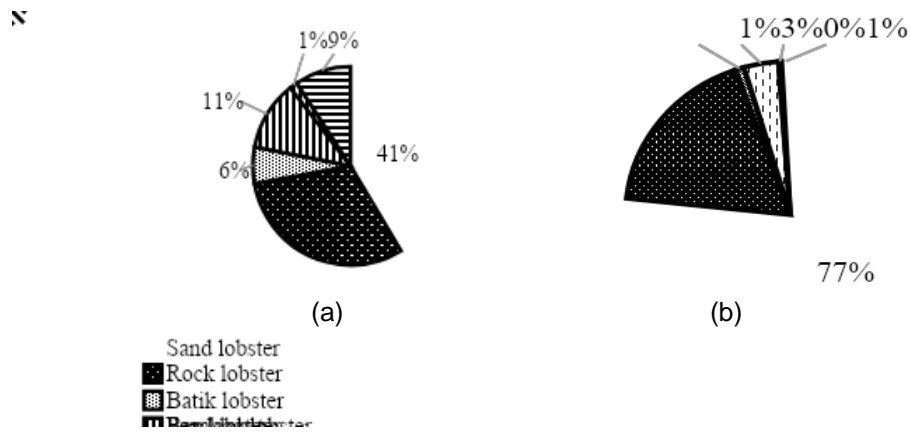
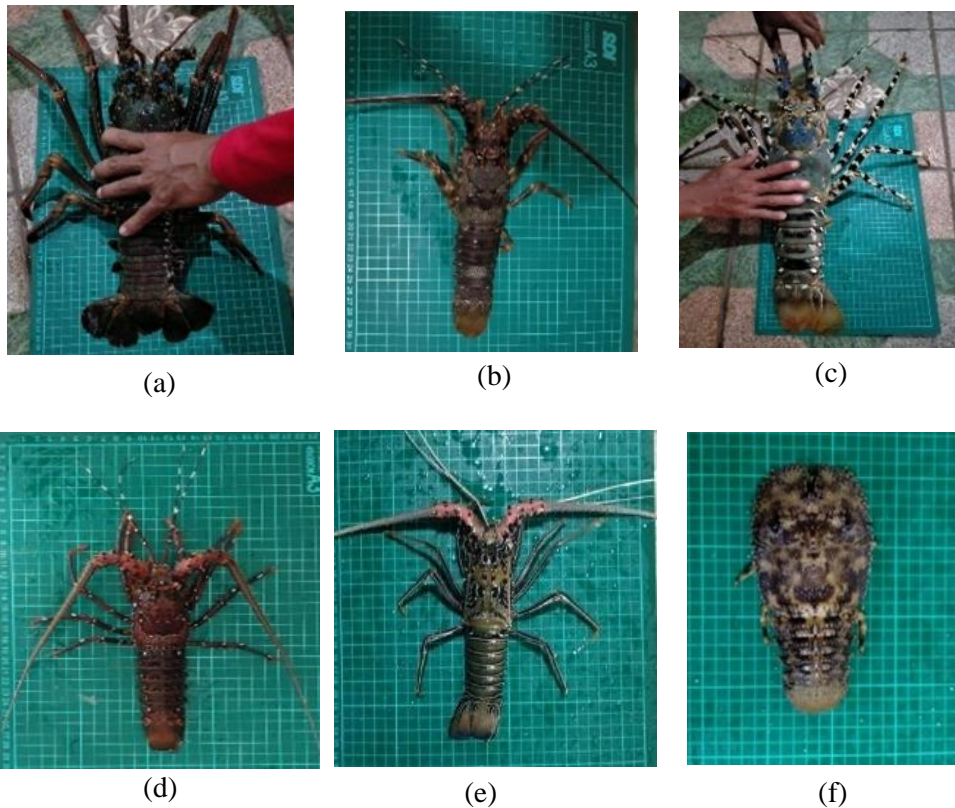


Figure 6 (a) Composition of lobster catch in Binuangeun Estuary, Lebak Banten_Indonesia (b) Composition of lobster catch in Cibareno Estuary, Lebak Banten_Indonesia

Catch Composition

Lebak Banten fishermen obtain lobster catches throughout the year in the waters of Lebak Regency, especially Cibareno Village and Muara Binuangeun Village. Fishermen obtained lobster catches in April, as many as

237 lobsters in Muara Binuangeun and 352 lobsters in Muara Cibareno. The catch of lobsters in Lebak waters are mostly female lobsters. Female lobsters caught from five species of lobster with non-laying conditions are 63% in the waters of Binuangeun Estuary while 49% in the waters of Cibareno Estuary.



Source: Research documentation

Figure 7 (a) *Panulirus penicillatus* (rock lobster), (b) *Panulirus homarus* (sand lobster), (c) *Panulirus ornatus* (pearl lobster), (d) *Panulirus longipes* (batik lobster), (e) *Panulirus versicolor* (bamboo lobster), (f) *Thenus orientalis* (fan lobster).

Table 1 Comparison of egg-laying and non-egg-laying female lobsters in April in the waters of the Binuangeun Estuary, Lebak Banten_Indonesia

Species	No lay eggs		Range of CL (cm)	Lay eggs		Range of CL (cm)
	individual	%		individual	%	
<i>Panulirus homarus</i> (sand lobster)	11	50	8.1-8.4	11	85	5.5-5.8
<i>Panulirus penicillatus</i> (rock lobster)	6	27	7.1-7.7	0	0	0
<i>Panulirus longipes</i> (batik lobster)	1	5	7.6-7.7	2	15	6.5-6.6
<i>Panulirus versicolor</i> (bamboo lobster)	4	18	6.5-7.0	0	0	0
<i>Panulirus ornatus</i> (pearl lobster)	0	0	0	0	0	0
Total	22	63%		13	37%	

Source: Research, April 2022

Table 2 Comparison of spawning and non-spawning female lobsters in April in the waters of Cibareno Estuary, Lebak Banten_Indonesia

Species	No lay eggs		Range of CL (cm)	Lay eggs		Range of CL (cm)
	individual	%		individual	%	
<i>Panulirus homarus</i> (sand lobster)	36	74	6.2-6.8	48	94	6.2-6.8
<i>Panulirus penicillatus</i> (rock lobster)	11	22	6.4-6.8	3	6	6.4-6.8
<i>Panulirus longipes</i> (batik lobster)	2	4	6	0	0	0
<i>Panulirus versicolor</i> (bamboo lobster)	0	0	0	0	0	0
<i>Panulirus ornatus</i> (pearl lobster)	0	0	0	0	0	0
Total	49	49%		51	51%	

Source: Research, April 2022

Table 3 Carapace size of lobster species caught in Binuangeun Estuary, Lebak Banten_Indonesia

No	Species	12/PERMEN-KP/2020 (>8 cm)		Reference average Lc(mm)	Reference Lc(mm)		Sex ratio		Number (individual)	References	
		below			below		Male (%)	Female (%)			
		Male	Female	Male	Female						
		(%)	(%)	Male	Female	(%)	(%)				
1	<i>Panulirus penicillatus</i> (rock lobster)	78	83	74	56	69	17	92	8	73	Chang <i>et al.</i> 2007
2	<i>Panulirus homarus</i> (sand lobster)	79	100	67	69	47	49	78	22	98	Kembaran <i>et al.</i> 2015
3	<i>Panulirus ornatus</i> (pearl lobster)	23	0	96	96	23	0	100	0	22	Tirtadanu and Yusuf 2018
4	<i>Panulirus longipes</i> (batik lobster)	91	100	55	54	27	0	79	21	14	Subani <i>et al.</i> 1983
5	<i>Panulirus versicolor</i> (bamboo lobster)	65	100	101	102,29	78	100	85	15	27	Triharyuni and Wiadnyana 2017
n (Total)									234		

Table 4 Carapace size of lobster species caught in Cibareno Estuary, Lebak Banten_Indonesia

No	Species	12/PERMEN-KP/2020 (>8 cm)		Reference average Lc(mm)		Reference Lc(mm)		Sex ratio		Number (individual)	References
		below				below		Male (%)	Female (%)		
		Male	Female	Male	Female						
		(%)	(%)	Male	Female	(%)	(%)				
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3	<i>Panulirus ornatus</i> (pearl lobster)	23	0	96	96	23	0	100	0	22	Tirtadanu and Yusuf 2018
4	<i>Panulirus longipes</i> (batik lobster)	91	100	55	54	27	0	79	21	14	Subani <i>et al.</i> 1983
5	<i>Panulirus versicolor</i> (bamboo lobster)	65	100	101	102,29	78	100	85	15	27	Triharyuni and Wiadnyana 2017
n (Total)										234	

Table 3 shows the results of the comparison of the carapace length size of each type of lobster based on PERMEN-KP No. 16 of 2022 and literature searches showing different percentage results. The percentage of lobster carapace length that refers to PERMEN-KP No. 16 of 2022, which is categorized as not worth catching, is female lobster 0 - 100% and male lobster 23 - 91%. The results of the comparison with several references categorized as not worth catching are female lobsters 0 - 100% and male lobsters 23 - 78%.

Table 4 shows the results of the comparison of the carapace length of each type of lobster based on PERMEN-KP No. 16 of 2022, and literature searches show different percentage results. The percentage of the

size of the lobster catch referring to PERMEN-KP No. 16 of 2022, which is categorized as not worth catching, is female lobster 0 - 100% and male lobster 0 - 98%. The results of the comparison with several references categorized as not yet feasible are female lobsters 0 - 94% and male lobsters 0 - 100%. The results of the percentage comparison show that the category not yet worth catching dominates the lobster resources in the waters of the Cibareno Estuary.

Sex Ratio

The sex ratio of sand lobster landed by fishermen in Binuangeun Estuary and Cibareno Estuary based on data collection time in April 2022 shows that the population is between males and females (Table 5).

Table 5 Sex ratio of sand lobster in Binuangeun Estuary and Cibareno Estuary, Lebak Banten_Indonesia

Location	Sex		Chi-Square		Sex ratio (M:F)	Results
	Male	Female	Xest	Xtab		
Binuangeun	76	22	59.5632	3.8414	1 : 0.29	Xest>Xtab then ≠1:1
Cibareno	186	84	149.3542	5.9914	1 : 0.45	Xest>Xtab then ≠1:1

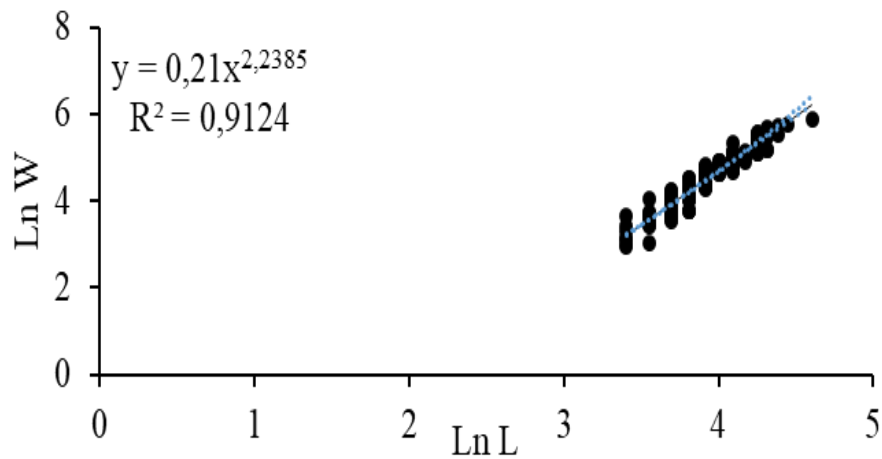


Figure 8 Length-weight of sand lobster relationship landed by fishermen in Lebak waters, Indonesia

Table 6 Research results of sand lobster growth patterns in Indonesian waters

Location	Year	b value	Growth pattern	Sources
Palabuhanratu	2016	2.119	negative allometric	Permana 2016
Aceh Jaya	2017	2.661	negative allometric	Irfannur <i>et al.</i> 2017
Pacitan	2013	2.754	negative allometric	Hargiyatno <i>et al.</i> 2013
Yogyakarta	2009	2.788	negative allometric	Aisyah and Triharyuni 2010
Lebak	2022	2.238	negative allometric	Present study

Carapace Length and Weight of Sand Lobster Relationship

Analysis of the length and weight of sand lobster relationship landed by fishermen in Lebak waters with measurements of 270 lobsters is presented in Figure 8. Based on the equation $W = aL^b$, the value of $b = 2.2385$ is obtained so that the equation is $W = 0,21L^{2,2385}$. The value of $b < 3$ for sand lobster so that the growth pattern is negative allometric, meaning that weight growth is not as fast as length growth.

Research on the length-weight of sand lobster relationship has been conducted in several waters presented in Table 6. The results of the study in Lebak waters show the same negative allometric growth pattern as that obtained in previous studies in other areas.

DISCUSSION

Fishermen use bottom gillnets or mangkara nets to catch lobsters in Lebak waters. The fishermen in Palabuhanratu waters also use the same fishing gear to catch lobsters (Khikmawati *et al.* 2017; Rombe *et al.* 2018) and fishermen in Aceh Jaya District

waters (Irfannur *et al.* 2017). Fishermen use lobster nets (rampus) because they can catch fish of various sizes, so this tool is not selective (Permana *et al.* 2016). The disadvantage of this fishing gear is that the net body is easily damaged by coral. The rampus net is operated by blocking the direction of fish movement, and then the fish is caught by the net body by entangling or twisting. The method of operation for catching lobsters is carried out by fishermen with a one-day fishing system by setting the net at night and then soaking it overnight, this is done because lobsters leave their hiding place to look for food at night (Gunarso 1986) and then the catch is taken the next morning.

Lobster fishing boats, namely minnow boats, function to transport labor and fishing gear from the fishing base to the fishing ground and transport the lobster catch. A minnow boat is a boat that has no shade or a very small house to shelter from the waves and rain (Nurdin *et al.* 2023). Generally, fishermen use instinct or personal experience to determine lobster fishing areas when conducting operations. Lobster fishing aids in Lebak waters, especially the Binuangeun area, use old tires.

The community generally has a profession as a fisherman because of the geographical conditions adjacent to coastal waters, so this profession is used as the main livelihood. The majority of these fishermen are small-scale fishermen with the characteristics of conducting fishing activities with a daily trip system (one-day fishing), a limited range of fishing locations, using simple and limited fishing equipment, and the fishing business is influenced by weather and season (Mintoro 2016). Lebak fishermen consist of several groups, namely ship owner, individual fishermen, and labor fishermen.

Lobster fishing areas are scattered throughout Lebak waters, generally carried out in the waters of Binuangeun Estuary, Rancecet Beach waters, Mantiung Beach waters, Karang Kembang Rangjang waters, and Bagedur Beach waters. According to Alhikmat (1999), lobster fishing areas are around Binuangeun waters and waters near Tinjil Islands, Deli, Tanjung Panto, Gunung Payung, Saringin to Ujung Kulon. The water area with a depth of 25-30 m has the characteristics of coral, mud, and sand substrate. According to Widiarti *et al.* (2021), one of the factors that can affect lobster abundance is the oceanographic conditions of waters, such as currents, salinity, temperature, and productivity levels (chlorophyll-a).

According to Boesono *et al.* (2011), one of the presumptive indicators for forecasting the fishing season is lobster caught in large numbers per month in an annual period (time series). Lobsters caught in large numbers occur from October to January, so it can be assumed that this month is the lobster fishing season. This is because in that month, there was a west monsoon wind and the onset of the rainy season, indicating that lobster fishing activities provided abundant catches. According to Damora *et al.* (2018), the occurrence of the rainy season phenomenon is one way to increase lobster catches. This is because the water temperature has decreased so this condition is following with lobster habitat which can cause lobster activity to increase around coral reefs (Sunarto *et al.* 2015).

Fishermen obtained 237 lobsters as their catch from Binuangeun Estuary, while 352 from Cibareno Estuary. The type of lobster in Lebak waters that is abundant is sand lobster with 368 individuals, while the least lobster is flathead lobster with four individuals. This happens because each type of lobster has different water habitats which

can cause differences in the number of catches. According to Alhikmat (1999), many types of sand lobster are caught allegedly because fishermen operate in the habitat and distribution of sand lobster, namely sandy coral substrates in the waters of Tinjil Island, Deli Island, and Mentiung.

The catch of lobsters in Lebak waters is mostly female lobsters. This is thought to be because the spawning season does not take place during April. According to Kintani *et al.* (2019), lobsters can spawn from October to December, with peak spawning occurring in October. Lobster eggs caught by fishermen should be released back into the water because the eggs attached to the abdomen will hatch in a short time. Abundant numbers of egg-laying lobsters caught may indicate a lack of selectivity in lobster fishing. Fishing selectivity for gillnets can be achieved by including the size caught and the age of the lobster (Sangadji *et al.* 2022). If this is not done in the long term, there is no opportunity for lobster to reproduce; this can lead to recruitment overfishing (Saputra 2009). The pressure on the sustainability of lobster resources is caused by the exploitation of lobster without any control over the capture.

The sex ratio of sand lobster in Lebak waters is in an unbalanced state. This result is similar to the results of research in West Aceh waters (Suman and Subani 1993). In contrast to the results of research in the waters of southern Bali (Subani *et al.* 1983) and Ekas-Lombok Bay (Junaidi *et al.* 2010), which found that the sex ratio of sand lobster is in a balanced state, where the female lobster dominates. The difference in the results of this study between the waters of South Bali and Ekas-Lombok Bay is thought to be caused by different environmental conditions, so the growth of lobsters becomes different. According to Effendi (2002), differences in sex ratio is caused by differences in behavior, environmental conditions, sex behavior, and fishing location.

The frequency distribution of carapace length for each type of lobster has different sizes in Lebak waters. The carapace length distribution of sand lobster ranges from 3 - 10 cm, rock lobster ranges from 3.5 - 18 cm, batik lobster ranges from 4 - 10 cm, bamboo lobster ranges from 4-12 cm, and pearl lobster ranges from 5-17 cm. This is also the case for sand lobster in West Aceh waters, with an average carapace length of 6.7 cm for males and 6.9 cm for females (Kembaren *et al.* 2015), rock lobster in the waters of the South China Sea with an average size of male lobster carapace

length of 7.4 cm and female lobster 5.6 cm (Chang *et al.* 2007), batik lobster in the waters of the South Coast of Bali with an average size of male lobster carapace length of 5.5 cm and female lobster 5.4 cm (Subani *et al.* 1983), bamboo lobster in Kupang waters of East Nusa Tenggara with an average size of male lobster carapace length of 10.1 cm and female lobster 10.2 cm, pearl lobster in Sorong waters of West Papua with an average size of male lobster carapace length of 9.6 cm and female lobster 9.6 cm (Triharyuni and Wiadnyana 2017, Tirtadanu and Yusuf 2018). The average size of the carapace length of male and female lobsters in each water body, such as the waters of West Aceh, the South China Sea, the waters of the South Coast of Bali, the waters of Kupang East Nusa Tenggara, and the waters of Sorong West Papua when compared to the average size of the carapace length of lobsters in Lebak waters has a different size. According to Kembaren *et al.* (2015), this is thought to be due to differences in environmental conditions and fishing pressure in each of these water locations. This is following with the statement of Widiarti *et al.* (2021) that the difference in the length of the lobster carapace is influenced by differences in environmental conditions and pressure in fishing efforts.

Length-weight measurements are conducted to determine the conversion and size of weight to length or vice versa, and then the results of the measurements can be used as an indication of health, productivity, obesity, physiological conditions, and gonad development (Merta 1993). The length-weight relationship shows that the growth pattern of sand lobster in Lebak waters is negative allometric ($b < 3$). This result is similar to the results of research in Palabuhanratu waters (Permana 2016) and Yogyakarta waters (Aisyah and Triharyuni 2010). Different b values are influenced by biological and ecological factors (Manik 2009). In addition, differences in growth models can be influenced by food availability and water temperature suitability (Monterio and Oliveira 2002).

CONCLUSION

Lobster fishing activities in Lebak Banten waters use polyamide monofilament rampus nets with mesh sizes of 3.5-4.0 inches. The fleet used is a wooden minnow boat with a size of 7 GT and 2-3 GT. The fishing operation is done by one-day fishing in the waters of Lebak and its surroundings with

the peak fishing season in December to January. The catch of lobster in Lebak waters during the study in April 2022 consisted of 6 types of lobster, namely sand lobster, rock lobster, batik lobster, bamboo lobster, pearl lobster, and flathead lobster. The sex ratio of lobsters in Lebak waters is unbalanced, and there is a negative allometric growth pattern. Based on PERMEN-KP No.16 of 2022, lobsters in Lebak waters for *P. Penicillatus* by 16%, *P. homarus* by 1-2%, *P. ornatus* by 0%, *P. longipes* by 100%, and *P. versicolor* by 8% are categorized catchable size.

RECOMMENDATION

The Maritime and Fisheries Service of Lebak Banten Regency needs to carried out a data collection scheme for lobster fisheries involving catch composition, the number of lobster fishers, the number of fishing gear, and trips for lobster fisheries management. Fishermen and lobster fisheries operators in Lebak Banten Regency need increased awareness and understanding regarding Ministerial Regulations Maritime Affairs and Fisheries of the Republic of Indonesia No. 16/PERMEN-KP/2022.

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