Fisheries Journal, 15 (2), 580-594 (2025)
http://doi.org/10.29303/jp.v15i2.1318

LEVEL OF UTILIZATION AND EFFORTS TO MANAGE MALE MACKEREL (*Rastrelliger kanagurta*) RESOURCES IN THE WATERS OF BANTEN BAY

Tingkat Pemanfaatan Dan Upaya Pengelolaan Sumberdaya Ikan Kembung Lelaki *(Rastrelliger Kanagurta)* Di Perairan Teluk Banten

Albertus Guntur Arsetyanto Labupili[1*], Meuthia Aula Jabbar[2], Tuty Maria Wardiny[1]

[1]Master of Fisheries Management Study Program Open University, [2]Aquatic Resources Management Technology Study Program Fisheries Business Expert Polytechnic

Cabe Raya Street, Pondok Cabe, Pamulang, South Tangerang, 15437

[*]Corresponding Author: albertus.guntur01@gmail.com

(Received December 9th 2024; Accepted April 27th 2025)

ABSTRACT

One of the main catches in Banten Bay with high commercial value is Indian mackerel (*Rastrelliger kanagurta*). Due to intensive exploitation, the Indian mackerel population declines yearly. This study aims to investigate multiple aspects, namely fishery biology and reproductive aspects, capture fishery aspects, and management efforts based on the exploitation status of R. kanagurta in Banten Bay. The research was conducted from July to October 2023 in 4 TPIs, namely TPI Lontar, PPN Karangantu, TPI Teratai, and TPI Wadas Bojonegara. The type of research conducted is survey research and quantitative. The analysis methods of this research are linear regression analysis of length-weight relationships, Chi-Square analysis, CPUE analysis, and MSY estimation. The results of the study on the biological aspect showed a negative allometric growth pattern with a *sex ratio* of 1:1,14 and TKG values in TKG III and TKG IV, with Lc > Lm. Regarding capture fishery, the predominant fishing gear was drift gill nets, boat cards, and fishing rods, with the trend between CPUE and effort decreasing. The MSY value is 605 tons and the JTB value is 484 tons. Management measures that can be taken to maintain the sustainability of male mackerel stocks are to limit fishing until optimal performance is achieved, close the season and fishing areas, limit the catch to the smallest fish size, the size of the net to regulate, and, most importantly, adequate supervision and socialization of fishermen in the context of sustainable management.

Keywords: Banten Bay, Fishing gear, Management, R. kanagurta, Resources.

ABSTRAK

Tangkapan utama nelayan di Teluk Banten dengan nilai komersial yang tinggi salah satunya adalah ikan kembung laki-laki (*Rastrelliger kanagurta*). Penurunan populasi terjadi pada ikan kembung lelaki dari tahun ke tahun karena eksploitasi yang intensif. Penelitian ini bertujuan untuk mengkaji beberapa aspek yaitu biologi, Bio reproduksi, perikanan tangkap, dan upaya pengelolaan berdasarkan status pemanfaatan *R. kanagurta* di Teluk Banten. Penelitian dilaksanakan pada bulan Juli – Oktober 2023 di 4 TPI yaitu, TPI Lontar, PPN Karangantu, TPI Teratai, TPI Wadas Bojonegara. Jenis penelitian yang dilakukan adalah penelitian survey dan bersifat kuantitatif. Metode analisis penelitian ini yaitu analisis regresi linier hubungan panjang-bobot, analisis *chi-square*, analisis CPUE, dan estimasi MSY. Hasil penelitian pada aspek biologi menunjukan pola pertumbuhan alometrik negatif dengan *sex ratio* 1:1,14 serta nilai TKG pada TKG III dan TKG IV, dengan nilai Lc > Lm. Pada aspek perikanan tangkap, alat tangkap yang dominan berupa jaring insang hanyut, bagan perahu, dan pancing ulur dengan tren menurun pada CPUE terhadap *effort*. Nilai MSY berada pada 605 ton serta JTB pada 484 ton. Sehingga upaya pengelolaan yang dapat dilakukan untuk menjaga kelestarian sumberdaya ikan kembung lelaki adalah dengan melakukan pembatasan penangkapan hingga mencapai upaya optimum, penutupan musim dan daerah penangkapan, pembatasan tangkapan pada ukuran ikan terkecil, pengaturan ukuran mata jaring, dan yang paling utama pengawasan yang memadai serta sosialisasi kepada nelayan terkait pengelolaan yang berkelanjutan.

Kata Kunci: Alat tangkap, Pengelolaan, *R. kanagurta*, Sumberdaya, Teluk Banten.

INTRODUCTION

The high demand for a fish species can cause exploitation activities of the species to become more intensive and as a result, public water fish resources are under pressure (Rosadi *et al*., 2020). Uncontrolled exploitation over time becomes a threat to the sustainability of the fish resources themselves. Meanwhile, fishing activities in Indonesia are already classified as overfishing and overcapacity, so sustainable fisheries development is needed.

Banten Bay is a water area located in WPP 712. Fishermen in WPP 712 waters generally carry out pelagic fishing activities with small pelagic fish catches, namely mackerel, tembang, mullet, and anchovies. The pelagic fish catch uses various fishing gear, including cantrang, gill nets, payang, handlines, boat lift nets, and fixed lift nets (PPN Karangantu, 2021).

Male mackerel (*R. ka nagurta*) is a fish with high commercial value and is the main catch of fishermen in Banten Bay (Rachmad *et al*., 2022). Exploitation of R. kanagurta is carried out intensively with hunting techniques that cause population decline from year to year (Katiandagho & Marasabessy, 2017). Sustainable utilization of fishery resources must be implemented immediately. Neglecting sustainable management can result in resources entering full exploitation. This is because the level of exploitation is uncontrolled and exceeds the carrying capacity of fishery resources (Adlina *et al*., 2016).

Management of fishery resources is an important aspect in the fisheries sector and if resources are not managed properly, it can result in reduced income from the fisheries sector from existing resources. Therefore, the purpose of this study was to examine the bio-reproductive aspects of fisheries and aspects of capture fisheries, so that it can be known how resource management efforts are based on the utilization status of R. kanagurta captured in Banten Bay.

METHODS

Place and Time

The research was conducted at 4 ports, namely TPI Lontar, PPN Karangantu, TPI Teratai, TPI Wadas Bojonegara which are located in the Banten Bay area. The selection of the location was determined based on the representation of several TPIs that are used as landing sites for male mackerel in Banten Bay. The research was conducted from July to October 2023. The research location can be seen in Figure 1.

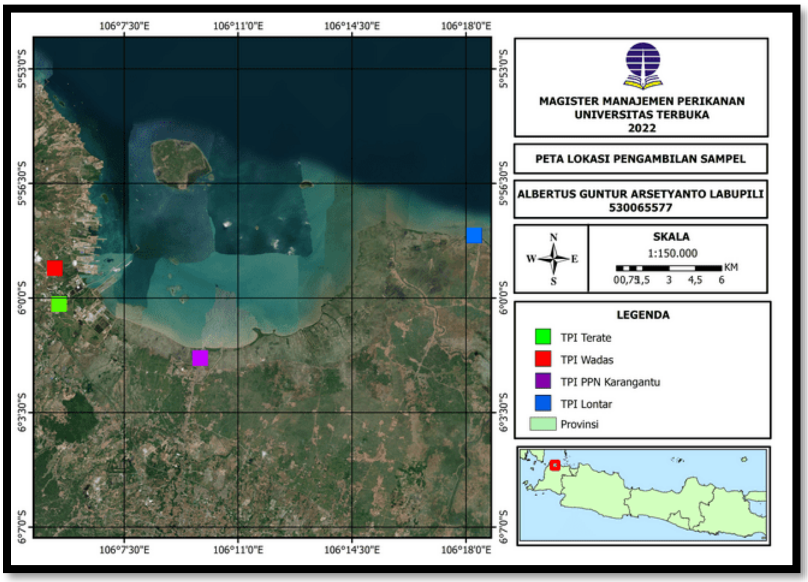

Figure 1. Research location

Tools and Materials

The tools and materials used in this study are presented in Table 1.

Table 1. Research tools and materials

No	Tools and Materials	**Accuracy/ Specifications**	Amount	Function
1	Ruler	0,1 cm	1 piece	Measuring fish
2	Digital scales	0,1 g	1 piece	Weighing fish
3	Camera	-	1 piece	Documenting activities
4	Stationery	-	1 piece	Recording data
5	Labels	-	1000 labels	Tagging samples
6	Questionnaire	-		Interviewing fishermen
7	White mat	100*200 cm	1 piece	Being a sample base
8	Dissecting set	-	1 set	Dissecting fish
9	Sample Fish	Mackerel	1000 heads	Observing biological aspects of fish

Research methods

Samples were taken using random sampling on ships landing at each port. Data collection was carried out using direct observation or by conducting interviews with ship owners. Measurement of fish length using a 30 cm ruler and fish weight using a 0.1 gram digital scale. Fish stomach surgery was carried out to observe sex and gonad maturity levels. The population observed was 1000 mackerel fish where 278 mackerel fish were used as samples according to the calculation in the Raosoft method.

Data Analysis

Length Weight Relationship

The relationship between the length and weight of fish is known by measuring the fish using a ruler to measure the length of the fish and a digital scale (accuracy 0.1 grams) to determine the weight of the fish. The equation for the relationship between length and weight is (Effendie, 1979):

$$W = aL^b$$

Information:
W = Fish weight (grams)
L = Fish fork length (cm)
a = Regression line intersection
b = Slope angle of the regression line

The linear form of the equation is:

$$\ln W = \ln a + b \ln L$$

Parameters a and b are obtained by linear regression analysis by entering ln L as the independent variable (x) and ln W as the dependent variable (y) to obtain the regression equation *y* = *a* + *bx*.

First time catch size (Lc)

The length of the first fish caught (Lc) is defined as the length of the fish where 50% of the fish are retained and 50% are released by a fishing gear. The formula used to obtain the Lc value (Masuswo & Widodo, 2016):

$$Y\ (\%) = \frac{100}{(1+a*e-b*x)}$$

Information:
Y (%) : Proportion retained at each length class point
a : Intercept coefficient
b : Slope
e : Exponential
x : First size caught (Lc)

Sex Ratio

The sex ratio can be obtained using the following formula (Dimenta *et al*., 2019):

$$\text{NK} = \frac{\sum_j}{\sum_b}$$

Information:
NK : Sex Ratio
b : Number of female sex
j : Number of male genitalia

After obtaining the percentage of the sex comparison, to find out whether there is a significant difference between the male and female comparison, we continue with testing and chi-square test using the formula (Wibowo, 2017):

$$X^2 = \frac{(fo - fe)^2}{fe}$$

Information:
X^2 : *Chi square*
f_0 : Frequency of observed biota
f_e : Expected biota frequencies

Gonad Maturity Level (TKG)

Determination of gonad maturity level by observing the characteristics of fish gonads dissected using a dissecting set (Persada *et al*., 2016). Determination of TKG criteria for mackerel gonads is listed in Table 2.

Table 2. Gonad Maturity Level (TKG)

No.	TKG Level	Female	Male
1.	I	The ovary is elongated forward in the body cavity like a thread with bright color, Smooth surface.	The testes are shorter at the end and visible in the body cavity, as smooth as thread, and have a bright color.
2.	II	The size of the ovary is larger. The color of the ovary is dark yellow. The eggs are not clearly visible to the naked eye.	The size of the testes is larger. The color of milk is white. The size of the testes is clearer than level I.
3.	III	The ovary is yellow. Morphologically, the eggs begin to be visually visible.	The surface of the testes looks serrated. The whiter the color and the larger the testes.
4.	IV	The ovary is large, the eggs are yellow and easy to separate. Fills 1⁄2 – 2⁄3 of the abdominal cavity.	When preserved, they are easy to break/break. The testes are getting harder.
5.	V	The ovary is wrinkled, thick-walled with remaining eggs near the release.	The testes at the back are deflated, while the part near the release remains filled.

Size of first gonad maturity (Lm)

Calculation of the length of fish when the gonad first matures (Lm) using the Spearman-Karber formula as follows (Abubakar *et al*., 2019):

$$\textbf{Log m} = X_k + \frac{X}{2} - (x\sum Pi)$$

Information:

Log m : Long class logarithm at first maturity
X_k : The logarithm of the last mean value at the time of gonad maturity of the fish (100%)
X : Difference in logarithms of class midpoints
X_i : Logarithm of the class midpoint
Pi : ri/ni
ri : Number of mature gonad fish in class i
ni : Number of fish species i

***Catch Per Unit Effort* (CPUE)**

The data obtained is entered into a table related to the number of catches and efforts with fishing gear. Then, the catch performance per unit effort (CPUE) is calculated using the formula (Noija *et al*., 2014):

$$CPUE = \frac{catch}{effort}$$

Information:
CPUE : Catch per fishing effort in year 1 (ton/unit)
Catch : Catch in year i (tons)
Effort : Fishing effort in year i (unit)

***Maximum Sustainable Yield* (MSY)**

Determination of the maximum sustainable potential (MSY) value with the formula is only valid if the parameter b is negative. This indicates that increasing fishing efforts will cause a decrease in CPUE. The magnitude of parameters a and b can be systematically searched using a linear regression equation with the formula (Sparre & Venema, 1998):

$$Y = a + bx$$

Information:
a: The intersection of the regression line and the y-axis
b: Slope of the regression line
x: Arrest attempts during period-i
y: Catch per unit effort in period i

The values of a and b can be found using the formula (Simanjuntak *et al*., 2019):

$$a = \frac{(\sum yi)(\sum xt^2) - (\sum xi)(\sum xiyi)}{n.\sum xt^2 - (\sum xi)^2}$$

$$b = \frac{n.\sum xiyi - (\sum xi)(\sum yi)}{n.\sum xt^2 - (\sum xi)^2}$$

Information:
a : *Intercept* (constant)
b : *Slope* (slope)
xi : Arrest attempts in period i,
yi : Catch per unit effort in period i

The values of a and b are already known, then calculate the catch and optimal fishing effort that can be obtained using the following equation. (Simanjuntak *et al*., 2019):

$$E_{MSY} = -\frac{1}{2} * a/b \,,$$

$$H_{MSY} = -\frac{1}{4} * a^2/b \,,$$

Information:
a : *Intercept*
b : Regression coefficient
E_{MSY} : Optimal fishing effort (trip)
H_{MSY} : Optimal catch (tons)

Total Allowable Catch (TAC)

Total Allowable Catch (TAC) or the amount of catch allowed is 80% of the sustainable potential (MSY). If the catch exceeds the MSY value, then fishing efforts in these waters experience full exploitation. Meanwhile, the optimum catch to remain sustainable is not to exceed the TAC value.

Utilization Rate

The utilization rate value is obtained based on the production results produced each year from the sustainable potential obtained. The formula that can be used is as follows (Rumambi *et al*., 2017):

$$\text{"Utilization Rate"} = \frac{C_i}{TAC} \text{ x } 100\%$$

Information:
C_i : Total production of catch in year i (tons))
TAC : Total allowable catch (80% MSY)

RESULT

Distribution of Fork Length

The results of observations on 1,007 male mackerel samples (*R. kanagurta*) obtained frequency distribution data which is presented in Figure 2. Based on the frequency distribution of fork length, it can be assumed that there is one age group in the mackerel stock in Banten Bay at a class width of 19-20 cm.

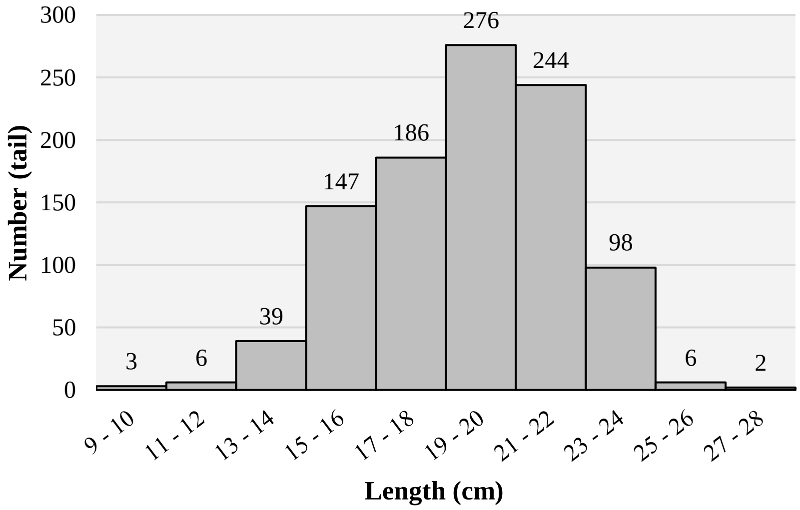

Figure 2. Frequency Distribution of Length of R. kanagurta Fish

Growth Pattern

Based on the results of the t-test on the b value, overall the growth pattern of R. kanagurta fish is negatively allometric with a b value = 2.88. So the growth of R. kanagurta fish is included in the negative allometric growth pattern (b <3) which is an increase in weight that is slower than its body length. So the fish will look thin and elongated. The close correlation between the length and weight of the fish can also be seen based on the results of the analysis W = 0.022 L2.88 with a coefficient of determination (R2) of 82.6%. The relationship between the length and weight of *R. kanagurta* fish is presented in Table 3 and Figure 3.

Table 3. Relationship between the length and weight of *R. kanagurta* fish

	Number of samples (n)	Intercept (a)	Slope (b)	T_{hitung}	T_{tabel}	Coefficient of determination (R^2)	Growth Pattern
Female	338	0,019	2,92	29,63	1,96	0,73	Negative allometric
Male	294	0,042	2,66	30,96	0,67	0,85	Negative allometric
Overall	1007	0,022	2,88	1,96	40,64	0,82	Negative allometric

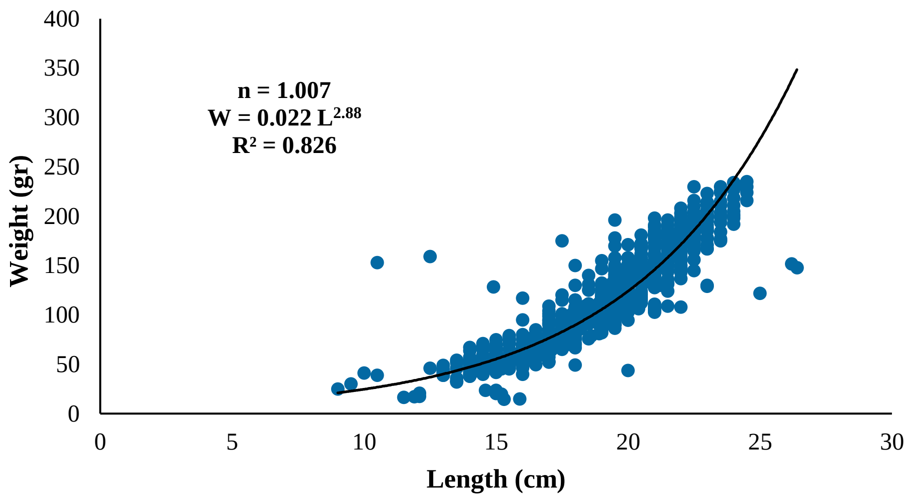

Figure 3. Length-weight relationship of R. kanagurta fish

First Time Caught Size (Lc)

The Lc value is the average length value when the fish was first caught. The results of this study show that the size of R. kanagurta caught in the waters of Banten Bay was 18.45 cm. The Lc value graph in this study is presented in Figure 4.

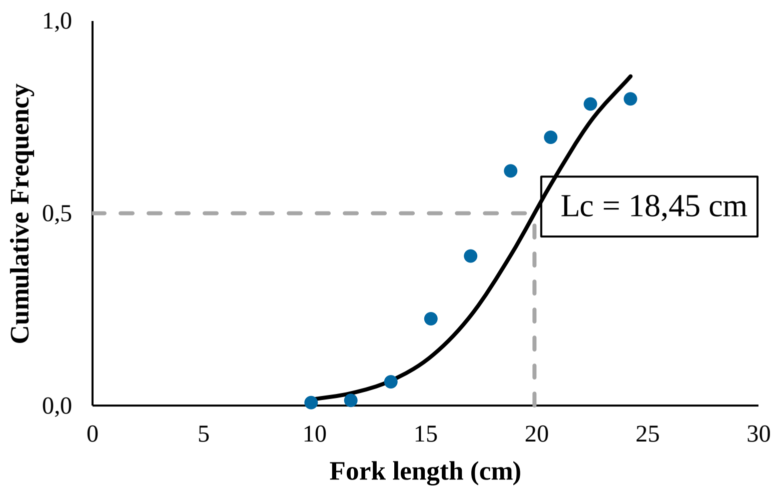

Figure 4. Size when first caught of R. kanagurta fish (Lc)

Gender Comparison (*Sex Ratio*)

Sex ratio is an important indicator in maintaining the balance of fish populations and regulating the number of catches so that they remain balanced (Parawangsan & Prawira, 2023). The results of the Chi-square test presented in Table 4 show that the ratio of male and female mackerel is 1: 1.14 with a calculated X2 value of 3.063 and an X2 table of 3.84.

Table 4. *Sex Ratio* of R. kanagurta

N Sampel	Amount		Sex Ratio	X^2_{hitung}	X^2_{Tabel}	Test Results
	Male	Female				
1.007	294	338	1 : 1.14	3,063	3,84	Balanced

Gonad Maturity Level (TKG)

The results of the observation of the gonad maturity level (TKG) are presented in Table 5. Of the 294 samples of male R. kanagurta fish caught, 69 (23%) were still in TKG I, 65 (22%) were in the TKG II category, 90 (31%) were in the TKG III category, and 70 (24%) were already in TKG IV. Meanwhile, of the 338 samples of female R. kanagurta fish caught in Banten Bay, 66 (19%) were still in TKG I, 60 (18%) were in the TKG II category, 117 (35%) were in the TKG III category, and 95 (28%) were already in the TKG IV phase category.

Table 5. Gonad Maturity Level (TKG)

TKG	Male (tail)	Percentage (%)	Female (tail)	Percentage (%)
I	69	23	66	19
II	65	22	60	18
III	90	31	117	35
IV	70	24	95	28
TOTAL	**294**	**100**	**338**	**100**

First Time Gonad Maturation Size

The results of observations on 632 R. kanagurta fish obtained a calculation analysis that the average size of the first gonad maturity (Lm) based on the level of gonad maturity and the distribution of length sizes was 14.12 cm. This shows that the size of the first time the fish were caught was still larger than the value of the first size of the fish when the gonads matured, which was 18.45 cm> 14.12 cm.

Catch Per-Unit of Effort (CPUE)

Based on the results of the CPUE value analysis from 2019 - 2023, it can be seen in Figure 5 that the CPUE value is very volatile. However, it can be seen that the trend is an upward trend, although not significant.

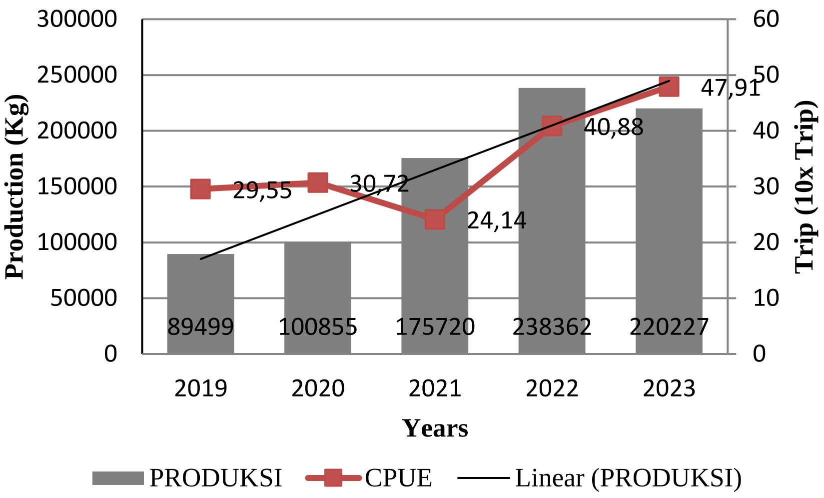

Figure 5. CPUE value of R. kanagurta fish in Banten Bay 2019 – 2023

The CPUE value obtained in this study shows a fluctuating value and is not always directly proportional to the amount of production produced and effort. This can be seen in 2021 with efforts made reaching 7,279 trips, it can produce 175,720 kg. While in 2022 with a smaller number of trips and almost 25% lower but obtained greater production results, namely 238,362 kg. The level of change that occurs is not always directly proportional, where at a high level of effort does not necessarily mean high production results, this is very dependent on productivity and is reflected in the CPUE (Listiyani *et al*., 2017).

Maximum Suistainable Yield (MSY)

The MSY value analysis in this study was obtained using the surplus production model approach with the Schaefer model. Based on the results of the model approach, the optimum value obtained was at 32,369 trips per year with a maximum sustainable catch of 605,584 kg per year (Figure 6).

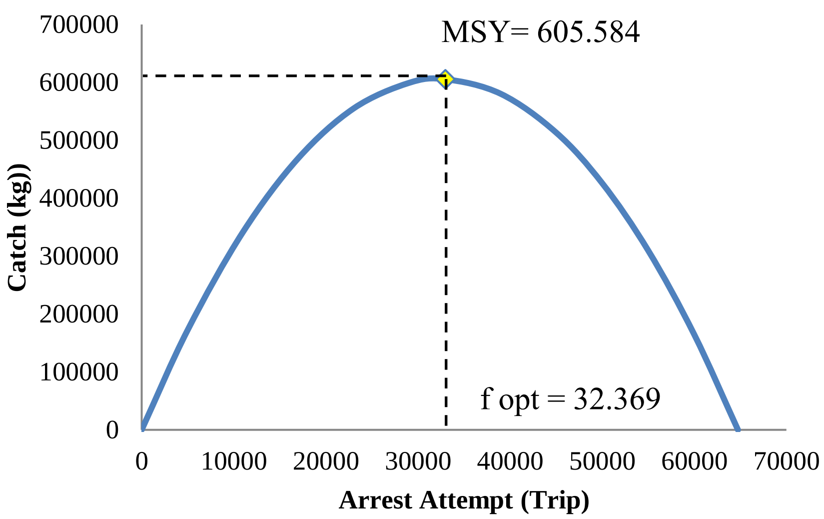

Figure 6. Maximum Sustainale Yield (MSY)

Total Allowable Catch (TAC)

The JTB value is 80% of the MSY value and in this study the JTB value was at 484.4 tons. Referring to the graph of the level of fish utilization presented in Figure 7, the level of utilization of mackerel in 2019 - 2023 experienced an increasing trend.

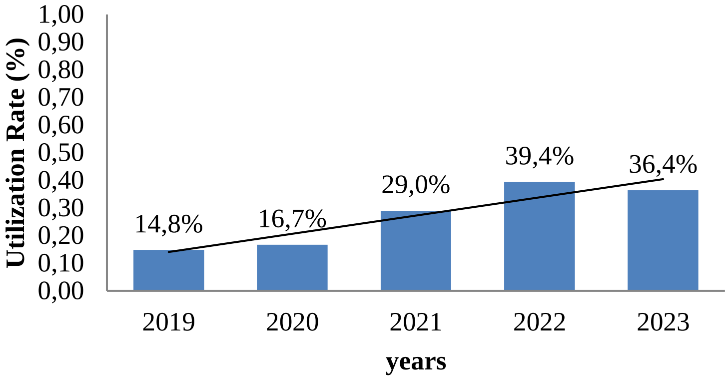

Figure 7. Level of utilization of R. kanagurta

DISCUSSION

The frequency distribution of fork length can be suspected of having one age group in the mackerel stock in Banten Bay at a class width of 19-20 cm. The same results were also obtained in the study of Rachmad *et al*., (2022), where the mackerel catch in October - December 2019 at PPN Karangantu at 1,010 fish had a frequency distribution between 10 - 30 cm. However, there are also differences such as in the study of Sari *et al*., (2022), where at PPN Labuan, Banten the maximum length of male mackerel obtained was 31 cm and females 29 cm, while the minimum length obtained in males was 10.5 cm and females 11 cm. The different fish distribution patterns are influenced by the oceanographic characteristics of Indonesian waters. However, based on interviews with fishermen who have been fishing in the Banten Bay area for a long time, the mackerel catch used to be larger than it is now. In addition, mackerel can still be found in waters less than <2 miles from land. This is different where it is now difficult to find and must be above 2 miles from land to get mackerel.

The relationship between the length and weight of R. kanagurta fish which is the basis of the growth pattern is useful for determining the size composition, the relationship between length and weight and condition factors. This is because fish growth factors will always be influenced by environmental conditions. Nasution & Machrizal (2023), said that there are several factors that cause a smaller b value, namely environmental factors, fish development, gender, fish stocks and can even be influenced by changes and differences in food caused by changes in time.

The Lc value in this study shows that the size of R. kanagurta caught in the waters of Banten Bay is 18.45 cm. Almost the same results were obtained in the study of Triyono *et al*., (2021), which stated that in 20 R. kanagurta in PPN Karangantu which were caught using gill nets, the average length when first caught was 18.58 cm. The Lc value is used to determine the minimum size that can be caught. This minimum size determination is used to maintain the availability of potential male mackerel fish so that it remains sustainable.

Sex ratio is an important indicator in maintaining the balance of fish populations and regulating the number of catches so that they remain balanced (Parawangsan & Prawira, 2023). The results of the percentage of male female mackerel sex ratio are 53% and male 47%. The percentage of unbalanced sex can be caused by environmental factors in the waters. This is supported by Astuti *et al*., (2019), who explained that water temperature or the environment affects the development of male and female gonads.

Based on the TKG value, it was found that more mature gonad fish were caught than immature gonads. The development of gonad maturity in fish can differ due to the genetic characteristics of the population, differences in growth rates and water quality, in addition to differences in regions and fishing pressure (Kasmi *et al.,* 2017).

The Lc value obtained was still greater than the Lm value, which was 18.45 > 14.12. Therefore, the capture of R. kanagurta fish in Banten Bay has not entered a condition of growth overfishing. Mackerel can be said to be suitable for catching if its size is larger than the Lm value and conversely, sizes below the Lm value are stated as unsuitable for catching (Tarigan *et al*., 2020). This was also reinforced by Kuswoyo & Rahmat (2022), who stated that fish that can be caught are fish whose body length is longer than the length of the first gonad maturity (Lm).

The CPUE value obtained in this study shows a fluctuating value and is not always directly proportional to the amount of production produced and effort. This can be seen in 2021 with efforts made reaching 7,279 trips, it can produce 175,720 kg. While in 2022 with fewer trips and almost 25% lower but obtained greater production results, namely 238,362 kg. Changes in CPUE values are not always directly proportional because large efforts do not necessarily produce greater production because this is very dependent on the productivity reflected through CPUE (Listiyani *et al*., 2017). The level of productivity of *R. kanagurta* fish can be influenced by several factors, namely water temperature, salinity, and spawning season. Things that affect when fishermen catch during the spawning season can threaten the productivity of *R. kanagurta* fish in the future.

Based on the MSY analysis with an optimum value of 32,369 trips per year and a maximum sustainable catch of 605,354 kg per year, the catch of *R. kanagurta* fish in Banten Bay can be said to have not reached maximum catch. However, it is approaching full exploitation so that management and supervision are needed by limiting catches to the optimum limit. The results of the utilization rate of R. kanagurta fish in 2019 were only 14.8%, in 2020 it increased to 16.7%, in 2021 it increased to 29%, and peaked in 2022 it increased to 39.4%. While in 2023 there was a decrease that was not too far, namely to 36.4%. This utilization has not reached 50% but when viewed from the CPUE graph against Effort and the MSY value obtained, it is approaching full exploitation.

Based on the bio-reproductive aspect of *R. kanagurta* fishing in Banten Bay, it is necessary to pay attention to the size of the fish caught and pay attention to the spawning season. The first step to maintain the size of the fish caught is to pay attention to the size of the mesh used. The mesh size must be larger than the Lm value, which is 14.12 cm. The recommended mesh size is $\geqslant$ 1.5 inches. In addition, the length of the rope used is also $\leqslant$ 500 meters. The conditions in the field are that the construction of drift net fishing gear for fishermen in Banten Bay already has a mesh size of $\geqslant$ 1.5 inches and a rope of $\leqslant$ 500 meters with a ship specification of $\leqslant$ 5 GT. Ohoiwait (2024), stated that the use of mesh must be carried out properly and carefully to avoid catching small fish which has an impact on excessive fishing.

Based on the results of the analysis of the fisheries aspect in this study, the graph of CPUE values against effort shows an upward trend. This shows that there is a decrease in fish abundance so that management can start to limit fishing efforts, where the maximum catch only reaches the optimum effort. One of the efforts to limit fishing can be done by paying attention to the spawning season. According to Putera (2019), the R. kanagurta spawning season occurs in September - November. So it is advisable for fishermen not to catch fish during that month.

Another step besides not fishing during the spawning season is to impose restrictions on fishing areas or routes. This is as stated in the Minister of Marine Affairs and Fisheries Regulation No. 36 of 2023, the measured fishing zone is divided into 4 routes, namely, Routes IA, IB, II, and III. Route IA covers waters up to 2 miles from the coastline. Route IB covers waters outside route IA up to 4 miles. Route II covers waters outside route I up to 12 miles.

Route III covers waters outside routes I and II including Indonesia's exclusive economic zone. If based on the drift gill net fishing gear and with a ship ⩽ 5 GT, then the fishermen must be on the fishing lane above IA, while the facts in the field there are still fishermen who catch fish in the IA area or lane. Therefore, this is what needs to be the attention of the authorities to carry out supervision and socialization to fishermen regarding sustainable management.

Efforts to manage fisheries if they can be implemented optimally can have a major impact on the community, one of which is the maintenance of the ecosystem and conservation of the potential of existing fish resources. Maintaining the potential of resources means that fishermen do not need to worry about the fish stock in the waters and can also get a more economical size.

CONCLUSION

The catch of mackerel in Banten Bay has a negative allometric growth pattern with a sex ratio of 1:1.14 and TKG values at TKG III and TKG IV, with Lc values > Lm. In the fisheries aspect, there is an upward trend in CPUE values. The MSY value is at 605 tons and JTB at 484 tons with the most widely used fishing gear being drift gill nets. So that management efforts that can be made to maintain the sustainability of mackerel resources in Banten Bay are to limit fishing to achieve optimum efforts, close the season and fishing areas, limit catches on the smallest fish size, regulate the size of the net mesh, and most importantly adequate supervision and socialization to fishermen regarding sustainable management.

ACKNOWLEDGEMENT

Acknowledgements are primarily addressed to the research funders. Acknowledgements can also be given to parties who assisted in the implementation of the research & writing of the manuscript.

REFERENCES

Abubakar, S., Subur, R., & Tahir, I. (2019). Pendugaan Ukuran Pertama Kali Matang Gonad Ikan Kembung (*Rastrelliger* sp.) di Perairan Desa Sidangoli Dehe Kecamatan Jailolo Selatan Kabupaten Halmahera Barat. *Jurnal Biologi Tropis*, *19*(1), 42-51.

Adlina, N., Boesono, H., & Fitri, A. D. P. (2016). Aspek Biologi Ikan Kembung Lelaki (*Rastrelliger kanagurta*) sebagai Landasan Pengelolaan Teknologi Penangkapan Ikan di Kabupaten Kendal. *Prosiding Seniati*, *2*(2), 91-95.

Astuti, S., Wiadnya, D. G. R. & Sukandar, M. (2019). Analisis Histologi Tingkat Kematangan Gonad Ikan Kembung Perempuan (*Rastrelliger brachysoma*, Bleeker 1851) di Perairan Lekok, Pasuruan. *JFMR (Journal of Fisheries and Marine Research)*, *3*(1), 8-21.

Dimenta, R. H., Machrizal, R., & Khairul, K. (2019). Informasi Morfologi Reproduksi dan Nisbah Kelamin Udang Mantis *Cloridopsis scorpio* (Latreile, 1828) di Perairan Ekosistem Mangrove Belawan. *Jurnal Pembelajaran dan Biologi Nukleus (JPBN)*, *5*(2), 24-33.

Effendie, M. I. (1979). *Metode Biologi Perikanan*. Bogor: Yayasan Dewi Sri.

Kasmi, M., Hadi, S. & Kantun, W., (2017). Biologi Reproduksi Ikan Kembung Lelaki, *Rastreliger kanagurta* (Cuvier, 1816) di Perairan Pesisir Takalar, Sulawesi Selatan. *Jurnal Iktiologi Indonesia*, *17*(3), 259-271.

Katiandagho, B., & Marasabessy, F. (2017). Potensi Reproduksi, Pola Pemijahan Serta Alternatif Pengelolaan Ikan Kembung Laki-Laki (*Rastrelliger kanagurta*) di Sekitar Pesisir Timur Perairan Biak. *Agrikan: Jurnal Agribisnis Perikanan*, *10*(2), 51-55.

Kuswoyo, A. H., & Mualim, R. (2022). Analisis Spasial dan Temporal terhadap Alternatif Strategi Pengelolaan Perikanan Ikan Kembung di Perairan Selat Sunda. *Buletin Jalanidhitah Sarva Jivitam*, *4*(2), 145-152.

Listiyani, A., Wiajayanto, D. & Jayanto, B. B., (2017). Analisis CPUE (*Catch Per Unit Effort*) dan Tingkat Pemanfaatan Sumberdaya Perikanan Lemuru (*Sardinella lemuru*) di Perairan Selat Bali. *Jurnal Perikanan Tangkap: Indonesian journal of capture fisheries*, *1*(01), 1-9.

Masuswo, R., & Widodo, A. A. (2016). Karakteristik Biologi Ikan Tongkol Komo (*Euthynnus affinis*) yang Tertangkap Jaring Insang Hanyut di Laut Jawa. *Bawal Widya Riset Perikanan Tangkap*, *8*(1), 57-63.

Nabila, A., (2023). The Analysis of Potential Resources of Small Pelagic Fish in Ambon City Waters. *Jurnal Perikanan dan Kelautan Tropis*, *12*(3), 94-98.

Nasution, S. Y. & Machrizal, R. (2021). Faktor Kondisi dan Hubungan Panjang Berat Ikan Duri (*Hexanematichthys sagor*). *BIOEDUSAINS: Jurnal Pendidikan Biologi Dan Sains*, *4*(2), 386-392.

Noija, D., Martasuganda, S., & Murdiyanto, B. (2014). Potential and Utilization of Water Resources in The Island Demersal Ambon Province Maluku. *Jurnal Teknologi Perikanan dan Kelautan*, *5*(1), 55-64.

Ohoiwait, J. (2024). Pengaruh Perbedaan Ukuran Mata Jaring terhadap Hasil Tangkapan Jaring Insang Dasar di Perairan Pantai Difur Kota Tual. *Jurnal Ilmu dan Teknologi Perikanan Tangkap*. *9*(2), 74-80.

Parawangsa, I. N. Y. & Tampubolon, P. A. (2023). Some Biological Aspects of Indian Mackerel (*Rastelliger kanagurta* Cuvier, 1817) in Bali Strait waters. *Omni-Akuatika*, *19*(2), 137-146.

Permen KKP No. 36 Tahun 2023 tentang Penempatan Alat Penangkapan Ikan dan Alat Bantu Penangkapan Ikan di Zona Penangkapan Ikan Terukur dan Wilayah Pengelolaan Perikanan Negara Republik Indonesia di Perairan Darat

Persada, L. G., Utami, E., & Rosalina, D. (2016). Aspek Reproduksi Ikan Kurisi (*Nemipterus furcosus*) yang didaratkan di Pelabuhan Perikanan Nusantara Sungailiat. *Akuatik: Jurnal Sumberdaya Perairan*, *10*(2), 46-55.

PPN Karangantu. (2021). Laporan Statistik PPN Karangantu.

Putera, M. L. A. (2019). Reproduksi Ikan Kembung Lelaki (*Rastrelliger kanagurta cuvier, 1816)* Kaitannya dengan Suhu Permukaan Laut di Perairan Selat Sunda. Bogor: IPB University.

Rachmad, B., Suharti, R., Maulana, I., Yusrizal, Y., Hutajulu, J., Kusumo, T.E., Kresnafi, Y. & Rahman, A., (2022). Pengelolaan Perikanan Pelagis Kecil yang Didaratkan di PPN Karangantu, Provinsi Banten–Studi Kasus Perikanan Kembung (*Rastrelinger spp*). *Jurnal Kelautan dan Perikanan Terapan (JKPT)*, *5*(2), 127-133.

Rosadi, E., Makmur, S., Subagdja, S., & Fatah, K. (2020). Dinamika Populasi dan Status Penangkapan Ikan Baung (*Hemibagrus nemurus* Cv) di Wilayah Hulu Sungai Barito Kalimantan Tengah, Indonesia. *Fish Scientiae*, *10*(1), 23-33.

Rumambi, D. Y., Rembet, U. N., & Sangari, J. R. (2017). Marine Sustainable Yield Analysis of Pelagic Fisheries in Sea Based on Catch Landing Data from Tumumpa Fishery Harber, Manado North Sulawesi. *Jurnal Ilmiah Platax*, *6*(1), 21-28.

Sari, I. P., Bramana, A. & Rahayu, S. M. (2022). Pola Pertumbuhan Ikan Kembung Lelaki (*Rastrelliger kanagurta*) yang didaratkan di PPP Labuan, Banten. *Aurelia Journal*, *4*(1), 107-113.

Simanjuntak, D. H., Lumingas, L. J., & Sangari, J. R. (2019). Potensi Lestari Perikanan Tangkap Tuna di Sekitar Perairan Provinsi Sulawesi Utara Berdasarkan Data Pelabuhan Perikanan Samudera (PPS) Bitung, Sulawesi Utara. *Jurnal Perikanan dan Kelautan Tropis*, 10(1), 18-27.

Sparre, P., & Venema, S. C. (1998). Introduction to Fish Stock Assessment. Part 1: Manual. *FAO Fisheries Technical Paper*, *306*(1).

Tarigan, D. J., Sasongko, A. S., Cahyadi, F. D., Yonanto, L. & Rahayu, B. D. (2020). Daerah Penangkapan Ikan Kembung (*Rastrelligger* sp.) di Selat Sunda pada Musim Peralihan. *Jurnal Teknologi Perikanan dan Kelautan*, *11*(1), 63-79.

Triyono, H., Muzakki, S. A. & Mulyoto, M. (2021). Studi Komparatif Alat Tangkap Jaring Insang dan Bagan Perahu terhadap Hasil Tangkapan Ikan yang didaratkan di Pelabuhan Perikanan Nusantara (PPN) Karangantu, Serang, Banten. *Buletin Jalanidhitah Sarva Jivitam*, *2*(2), 69-81.

Wibowo, A. (2017). Uji Chi-Square pada Statistika dan SPSS. *Jurnal Ilmiah Sinus*, *4*(2). 37-46