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STOCK STUDY OF RED SNAPPER (LUTJANUS MALABARICUS) FOR SUSTAINABLE MANAGEMENT AT TPI TASIK AGUNG II OF REMBANG REGENCY, INDONESIA

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ABSTRACT
Red snapper (Lutjanus spp.) is one of the leading commodities in FMA 712. According to the Fisheries and Marine Service of Rembang Regency in 2020, the trend of Red Snapper production has always increased over the last 5 years (2016-2020). The existing trend of Red Snapper fishery production is inversely proportional to the state of potential demersal fish resources in WPP 712 which are already fully exploited. Fish resources that are open access must always be monitored and their utilization regulated. The purpose of this study was to examine the condition of the red snapper stock in the waters of WPP 712 which landed in Rembang. This research was conducted in June 2022. The data analysis consisted of: the relationship between length and weight, condition factors, exploitation rate, and surplus production model. The results showed that red snapper had a negative allometric growth pattern. The natural mortality value (M) is 1.43, the fishing mortality value (F) is 0.74. The exploitation rate of red snapper has exceeded the optimum exploitation rate so that the red snapper in FMA 712 is thought to have overfished. Management that can be suggested is through limitation of fishing units and selectivity of fishing gear.

KEY WORDS
Lutjanus malabaricus, stock study, sustainable management.

Fishing has a direct or indirect impact on marine ecosystems both dynamically, spatially and temporally. Fishing operations will affect the target fish species, by catch and habitat (environment). Fishing activities in Indonesian waters based on the data contained in the Decree of the Minister of Marine Affairs and Fisheries Number 45 of 2011 have approached critical conditions for both pelagic and demersal fisheries. Red snapper (Lutjanus spp.) or in the local language commonly referred to as bambangan is one of the demersal fish that has important economic value for the fishermen of Pantura Java, especially in Rembang Regency. This is confirmed by (Flikac et al. 2020), which states that Red Snapper is a long-lived demersal fish species that has a high commercial status value.

The fishery potential of Rembang Regency is basically very large, including having a sea area with a coastline of 65 km. This condition makes the majority of the population in Rembang Regency make the fishery sector their main livelihood. With various efforts made to the maximum, then the community can explore and exploit the natural wealth contained in it to meet the needs of life. The exploration of marine potential, especially in the field of capture fisheries, has shown significant progress as evidenced by the increasing trend of fishery production data every year.

Continuous fishing is done without paying attention to sustainability, it will damage the environment. The occurrence of various environmental damage, and uncontrolled exploitation of fish resources is feared to threaten its sustainability, so it is necessary to manage fish resources (Purwaningsih *et al*., 2012). Sustainable management of fish resources requires several studies that are collected in time series, including biological studies of target species. However, there is very little biological information regarding the red snapper that landed in Tasikagung Rembang, making it difficult to manage these fish resources. Therefore, it is necessary to study the biology of red snapper in the waters of

WPP 712 in general so that it can be used as the basis for proper management of these fish resources. The purpose of this study was to determine the study of red snapper stocks whose results are expected to provide information for sustainable management of fish resources.

METHODS OF RESEARCH

The research was carried out on June 1-20 2022, which took place in Rembang Regency. Here is a map of the research location:

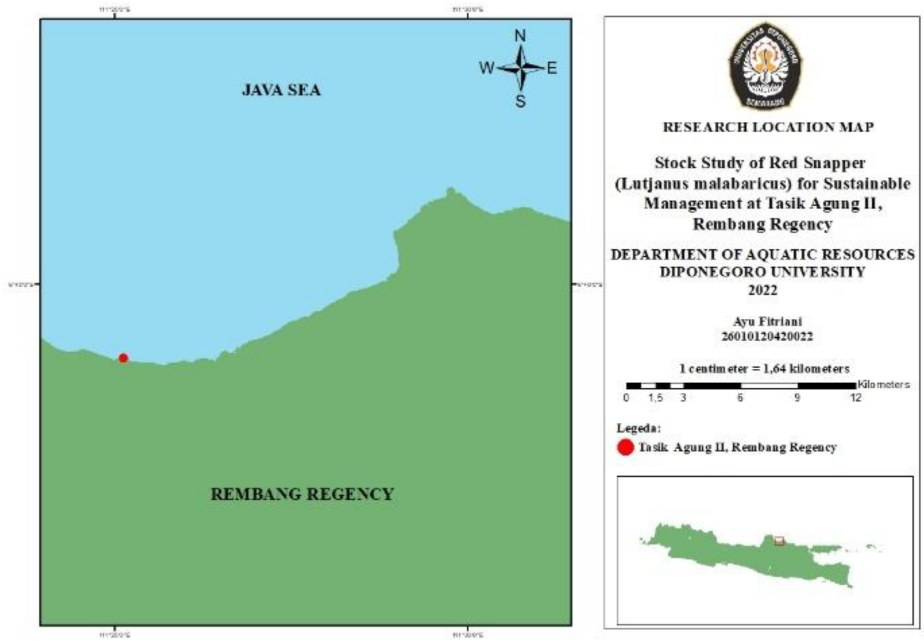

Figure 1 – Map of the research location

Sampling of red snapper was carried out 15 times in one month with a period of 2 days. Fish samples obtained amounted to 300 fish. The fish were then measured for their total length and weight. Measurement of length using a measuring board with an accuracy of 1 mm. Fish weight was measured using a digital scale with an accuracy of 1 gram. The sampling of fishermen's respondents was carried out using a random sampling technique on fishermen who caught red snapper with marsupial pulling nets.

The length frequency distribution is obtained by determining the number of class intervals, the width of the class intervals and the frequency of each class. The frequency distribution of predetermined lengths in the same class interval is then plotted in a graph.

Estimation of growth parameters is carried out using the growth formula that has been formulated by Von Bertalanffy:

$$Lt = L\infty \{1-e^{-k(t-to)}\}$$

Furthermore, to determine to use Pauly's (1980) formula, namely:

$$Log\ (-t_o) = -0{,}3922 – 0{,}2752\ (log\ L\infty) – 1{,}038\ (log\ K)$$

L∞ is the theoretical maximum length of the fish (asymptotic length), K is the coefficient of growth rate (per unit time) and t0 is the theoretical age of the fish when the length is zero.

The length-weight relationship is a description of the condition of the fish and determines whether the growth is isometric or allometric (Sudarno *et al*., 2018). According to Effendie (2002) the general formulation used to calculate the length of the weight is:

$$W = aL^b$$

Where: W = Weight (g); L = Total length (mm); a, b = konstanta.

The value of b<3 means that the growth in length is faster than the growth of weight (negative allometric), while the value of b>3 means that the growth of fish weight is faster than the length of the fish (positive allometric). On the other hand, if the value of b = 3 means that the growth pattern of fish is isometric, that is, length growth is balanced with fish body weight (Sudarno *et al*., 2018).

According to Windarti (2020), if the value of r is close to 1, it means that there is a strong relationship between the length and weight of the fish, and if the value of r is not close to 1, it means that the relationship between the length and weight of the fish is weak. Strong correlation means that the weight of the fish will increase as the length of the fish's body increases. A strong correlation is also suspected due to the availability of sufficient food and favorable environmental conditions for fish growth. Condition Factors Condition factors describe the bulkiness of the fish expressed based on length and weight data. The condition factor shows the good condition of the fish in terms of physical capacity for survival and reproduction. The use of commercial condition factor values has an important meaning in determining the quality and quantity of fish meat available for consumption (Wujdi *et al*., 2012).

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$$Kn = \frac{W}{aLb}$$

Where: W = weight (gram).

Effendie (2002) states that fish with slightly flat bodies have condition factor values ranging from 3-4 and for fish with less flat bodies, condition factor values ranging from 1-3. Variations in condition factor values depend on population density, gonadal maturity level, diet, sex and age of fish.

The natural mortality rate (M) was estimated using the formula created by Pauly (1980) in Sparee and Venema (1999) as follows:

$$Ln\ M = 0{,}0152\text{-}0{,}279 + \ln L\infty + 0{,}6543 + \ln K + 0{,}463 + \ln T$$
$$M = 0{,}8\ e^{(\ln M)}$$

Where: M = Natural Mortality; L∞ = Asymptotic length; K = Coefficient; T = Water temperature (^{0}C).

Catch mortality rate (F) determined by:

$$F = Z\text{-}M$$

The exploitation rate is determined by comparing the fishing mortality (F) to the total mortality (Z) (Pauly, 1984):

$$E = F/F+M = F/Z$$

The fishing mortality rate (F) or the optimum exploitation rate according to Gulland in Sparee and Venema (1999) are:

$$F_{optimum} = M \text{ and } E_{optimum} = 0{,}5$$

RESULTS AND DISCUSSION

Rembang Regency is regency located on the North Coast of Central Java Province, with an area of about 1,014 km² with a coastline of 63 km². 35% of the total area of Rembang Regency is a coastal area of 355.95 km2. Of the 14 sub-districts in Rembang district, 6 of them are located by the sea. The 14 sub-districts include Kaliori, Sumber, Sulang, Rembang, Lasem, Sluke, Pancur, Sedan, Pamotan, Bulu, Sale, Kragan, Sarang, and Gunem. Districts belonging to coastal areas include Kaliori, Rembang, Lasem, Sluke, Kragan, and Sarang. The number of villages in Rembang Regency is 287 villages and 7 urban villages with a total area of 101,408 ha (Wijayanto *et al*., 2018).

The marine and fishery sector is the center of attention of the Rembang Regency Government considering its vast marine waters. Success in marine fisheries management cannot be separated from adequate facilities and infrastructure. For this reason, Rembang Regency has 10 Fish Auction Places that support fisheries management in Rembang. The Fish Auction Place (TPI) Tasik Agung II is one of the largest TPIs in Rembang Regency. TPI Tasik Agung II facilitates special vessels with fishing nets. Pull the marsupials to land their catch.

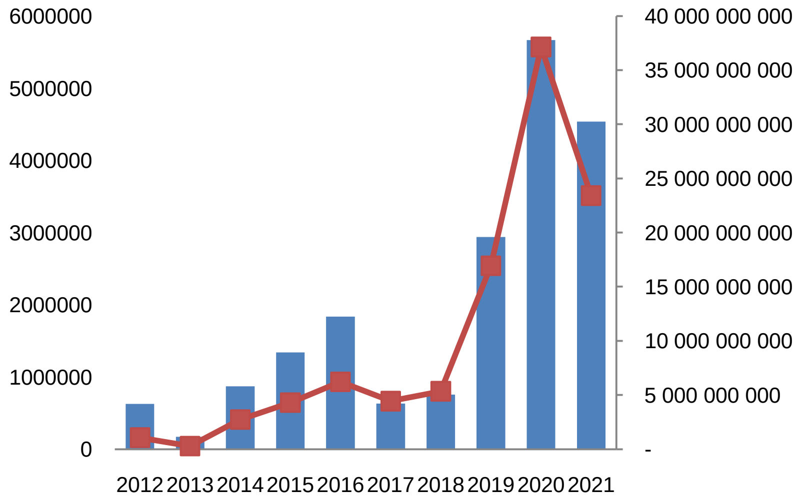

Figure 2 – Production and Production Value of Red Snapper in Rembang Regency
(Source: Marine and Fisheries Service of Rembang Regency)

Red Snapper is one of the demersal fish that has important economic value in Indonesia. This fish also dominates the production of demersal fish landed in Rembang Regency. It can be seen in the picture that from 2012 until now the production of Red Snapper tends to increase. This higher production indicates that fishing efforts, especially those carried out by marsupial net fishermen, are increasing. When it comes to the stock of fish resources, catching Red Snapper should be a concern and a challenge in itself. Given that based on the Decree of the Minister of Marine Affairs and Fisheries which presents the availability of fish stocks in nature, demersal fish resources have reached the point of fully exploited, which means they can still be caught but with strict supervision. If the fishing effort is increasing every year, it is not impossible if the Red Snapper fish resources will be depleted.

Analysis of the length and weight relationship was used to determine the growth patterns of fish (Bintoro *et al*., 2022). In this study, a sample of 300 fish was used.

The length of the red snapper obtained during the study with a sample of 300 fish was at most with a size of 20-26 cm. This size is relatively smaller than the size of the red snapper that has matured gonads, which is around 50 cm. This measure indicates that the catch is taking place using non-selective fishing gear. Catching small fish if it takes place continuously will result in reduced fish stocks in nature.

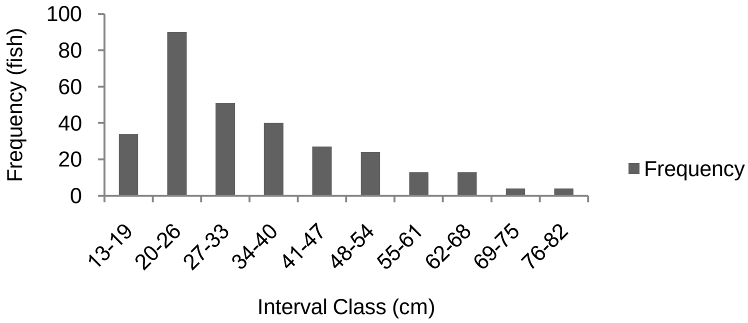

Figure 3 – Length Frequency Distribution

Assuming that the stock is in pristine condition, the presence of large and sexually mature individuals may be considered a healthy structure of fish populations. Conversely, reduction in the size distribution of the adult stock or recruits to a fishery that affect the proportion of large individuals is generally attributed to high fishing mortality over long periods of time.

Analysis of the relationship between length and weight of fish was used as an effort to see the growth pattern of red snapper in the waters of WPP 712 which landed in Rembang Regency.

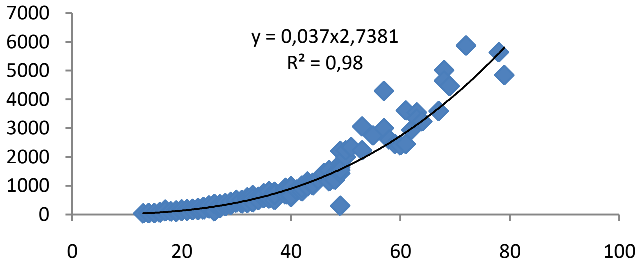

Figure 4 – Fish Weight Length Relation

Based on the graph in the figure, it is known that the b value of the length and weight equation of red snapper is 2.7193, which means the b value <3. This value means that the growth or weight gain of fish is negative allometric where the length increase is faster than the weight of the fish. The relationship between the length and weight of the red snapper landed in Rembang shows a correlation coefficient of 0.98, which means that there is a close relationship between the length and weight of the fish. 98% of fish weight is influenced by fish length and 2% comes from other factors.

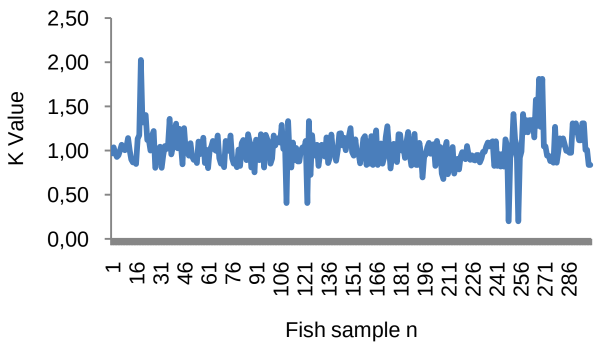

Figure 5 – The condition factor

From the figure, it can be seen that the average value of the red snapper condition factor in each sampling did not occur in extreme temporal variations, even relatively the same. The average value of the condition factor of red snapper during observation ranged from 0.4 to 3. This indicates that the sample fish at the time of observation were in a fat condition (less flat). If you get a K value ranging from 1-3, it means that the fish is not flat or fat (Effendie, 1997). If the condition of the fish is not good, the fish population may be too dense and vice versa if the condition is good, there may be a reduction in population or sudden food availability (Effendie, 1997). Variations in the value of the condition factor depend on food, age, sex, and gonad maturity. If there is a sudden change in the condition of the fish in water, this situation makes it possible to investigate (Rachmanto *et al*., 2020).

Total mortality (Z) in a capture fisheries activity is very important in analyzing fish population/stock dynamics. The abundance of fish in an age group at a certain time can be caused by several factors, both natural (natural mortality/M) and fishing (mortality due to capture/F), so that it can be described through the mortality coefficient.

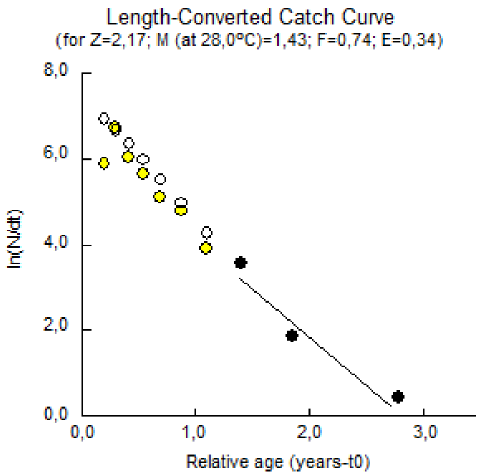

Figure 6 – Length-Converted Catch Curve from FISAT

Based on the analysis of the catch conversion curve (Figure), the mortality due to capture (F) of red snapper is 0.74 less than the natural mortality of 1.43. Natural mortality can be affected by disease, predators and environmental conditions. Meanwhile, fishing mortality is influenced by fishing gear and fishing frequency. The fishing mortality is smaller than natural mortality, indicating that actually fish stocks in nature can still be controlled by the perpetrators of fishing. The exploitation rate gets a value of 2.17. A value of E> 0.5 means that in the waters of WPP 712 this has been overfished and must be controlled immediately.

Based on the results of the research that has been done, suggestions can be given in the management that needs to be done:

- Setting the fishing season;
- Setting the limit on the size that can be caught (minimum legal size). To preserve the red snapper, it is recommended that fish are caught at a size larger than Lm, which is more than 54 cmTL;
- Regulating fishing effort and using environmentally friendly fishing gear;
- Create a special team that focuses on studying fish stocks in nature;
- The need to implement a systematic monitoring and data collection system in order to obtain accurate data as a basis for making management plans.

CONCLUSION

Continuous fishing must pay attention to resource sustainability. A sustainable fisheries management is needed. Knowing the condition of fish stocks in nature is a step to dig up information that can be used as a management reference. Based on the research that has been done, the red snapper caught are immature gonads. Has negative allometric growth with M value of 1.43, F value of 0.74, Z value of 2.17. A value of E> 0.5 means that in the waters of WPP 712 this has been overfished and must be controlled immediately.

REFERENCES

1. Bintoro G, D. Setyohadi, T. Djoko L, R. Affif N, A. Syawli and Muammar. 2022. Sustainable management of fisheries resources in Java Sea: Utilization status of longtail tuna (Thunnus tonggol) in Indramayu waters West Java case study. E3S Web of Conferences 339, 04001. https://doi.org/10.1051/e3sconf/202233904001
2. Effendie M I. 2002. Biologi Perikanan. Yayasan Pustaka Nusatama. Yogyakarta. 122 hlm.
3. Flikac, Tomislav, Denham G. Cook, William Davison, and Alistair Jerrett. 2020. 'Seasonal Growth Dynamics and Maximum Potential Growth Rates of Australasian Snapper (Chrysophrys Auratus) and Yellow-Eyed Mullet (Aldrichetta Forsteri)'. Aquaculture Reports 17(March): 100306. https://doi.org/10.1016/j.aqrep.2020.100306.
4. Pauly D. 1984. Some Simple Methods for Assessment of Tropical Fish Stocks. ICLARM. Manila. 52p.
5. Purwaningsih R, Widjaja S, Partiwi S G. 2012. Pengembangan model simulasi kebijakan pengelolaan ikan berkelanjutan. Jurnal Teknik Industri. 14(1): 25-34.
6. Rachmanto D, Djumanto and E. Setyobudi. 2020. Reproduksi Ikan Kembung Lelaki Rastreliger kanagurta (Cuvier, 1816) Morodemak Kabupaten Demak. Jurnal Perikanan Universitas Gajahmada. 22(2) : 85-91. DOI 10.22146/jfs.4844
7. Sparre P, Venema S C. 1999. Introduksi Pengkajian Stok Ikan Tropis. Jakarta:Pusat Penelitian dan Pengembangan Perikanan. 438 hlm.
8. Sudarno., Asriyana dan H. Arami. (2018). Huungan Panjang Berat dan Faktor Kondisi Ikan Baronang (Siganus sp.) di Perairan Tondonggeu Kecamatan Abeli Kota Kendari. Jurnal Sains dan Inovasi Perikanan. Fakultas Perikanan dan Kelautan Universitas Halu Oleo. Kendari, Indonesia. 2(1):30-39.
9. Windarti. (2020). Keterampilan Dasar Biologi Perikanan. Oceanum Press: Pekanbaru, Riau.
10. Wujdi, A., Suwarso dan Wudianto. (2012). Hubungan Panjang Berat, Faktor Kondisi dan Struktur Ukuran Ikan Lemuru (Sardinella lemuru Bleeker,1853) di Perairan Selat Bali. Jurnal. Pusat Penelitian Pengelolaan Perikanan dan Konservasi Sumberdaya Ikan. 4(2):83-89.