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YELLOWFIN TUNA (*Thunnus albacares*) FISHERIES SUSTAINABILITY: A WEIGHT-LENGTH ANALYSIS IN THE WEST SUMATERA WATERS

KEBERLANJUTAN PERIKANAN TUNA SIRIP KUNING (*Thunnus albacares*): ANALISIS PANJANG BERAT DI PERAIRAN SUMATERA BARAT

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ABSTRACT

Yellowfin tuna is a high-value fishery commodity and the primary source of livelihood for fishers in West Sumatra. However, fishing intensification often overlooks the selectivity of fishing gear, resulting in the capture of fish that are not yet suitable for fishing, which disrupts population regeneration, reduces biomass, and increases the risk of overfishing. Information on suitable catch size is important to support fisheries sustainability. This study aims to determine the distribution of fish length growth patterns and assess the catchability level of tuna (*Thunnus albacares*). Fish length and weight were collected by measuring tuna catches. Fish length and weight distribution were analyzed descriptively, while fish growth patterns were determined using the equation $W = aL^b$. The study shows that the tuna measured from June to August 2020 reached 398 individuals. In addition, the dominant fish caught ranged from 135 to 144 cm and between44 and60 kg. The analysis of fish distribution produced a regression equation $y = 0.00005x^{2.7787}$, with an R^2 value of 0.9575 and a b value of 2.4969, which indicates a negative allometric growth pattern, indicating that growth in fish length is more dominant than its weight growth. The results of this study indicate that 81% of tuna meet the criteria for catchability, while the others are unsuitable for catchability. This study was important in supporting the sustainable management of yellowfin tuna fisheries based on catchability size.

Keywords: east monsoon, length distribution, length-weight relationship, *Thunnus albacares*, waters off West Sumatra

ABSTRAK

Ikan tuna sirip kuning adalah komoditas perikanan bernilai tinggi dan sumber utama mata pencaharian nelayan di Sumatra Barat. Namun, intensifikasi penangkapan sering mengabaikan selektivitas alat tangkap, sehingga ikan belum layak tangkap turut tertangkap, mengganggu regenerasi populasi, menurunkan biomassa, dan meningkatkan risiko *overfishing*. Informasi ukuran layak tangkap penting untuk mendukung keberlanjutan perikanan. Penelitian ini bertujuan untuk mengetahui distribusi ukuran panjang ikan, pola pertumbuhan ikan dan menentukan tingkat kelayaktangkapan ikan tuna (*Thunnus albacares*). Data distribusi ikan, seperti panjang dan berat ikan dikumpulkan melalui pengukuran langsung terhadap hasil tangkapan nelayan. Distribusi ukuran dan berat ikan dianalisis secara deskriptif, sedangkan pola pertumbuhan ikan ditentukan menggunakan persamaan $W=aL^b$. Jumlah ikan tuna yang berhasil diukur selama periode Juni-Agustus 2020 mencapai 398 ekor. Ikan yang paling dominan tertangkap berkisar antara 135-144 cm dengan berat 44-60 kg. Analisis distribusi ikan menghasilkan persamaan regresi $y = 0{,}00005x^{2{,}7787}$, dengan nilai $R^2 = 0{,}9575$ dan nilai b = 2,4969. Nilai b yang lebih kecil dari 3 mengindikasikan pola pertumbuhan alometrik negatif, di mana pertumbuhan panjang ikan lebih dominan dibandingkan pertumbuhan beratnya. Hasil penelitian ini menunjukkan bahwa 81% ikan memenuhi kriteria layak tangkap, sedangkan 19% lainnya tergolong tidak layak tangkap. Penelitian ini memberikan kontribusi penting dalam mendukung pengelolaan perikanan tuna sirip kuning yang berkelanjutan berbasis ukuran layak tangkap.

Kata kunci: distribusi ukuran panjang, hubungan panjang-berat ikan, musim timur, perairan Sumatra Barat, *Thunnus albacares*

INTRODUCTION

Yellowfin tuna (*Thunnus albacares*) is a pelagic fish species that plays an important role in international fisheries trade due to its high economic value. Indonesia, as one of the world's main tuna producers, has abundant tuna resources, including in the waters of West Sumatra (Siregar *et al.* 2018; Nugroho *et al.* 2020; Syah *et al.* 2020; Amri *et al.* 2021). This area is known for its seasonal current dynamics, particularly during the east monsoon, which enhances fisheries productivity (Simbolon *et al.* 2013; Siregar *et al.* 2019; Syah *et al.* 2020). During this period, the availability of yellowfin tuna increases, allowing fishermen to capitalize on the opportunity to increase their catch (Satria *et al.* 2019).

Intensification of fishing activities, especially during the abundant season, often does not pay attention to the selectivity of fishing gear. The use of fishing gear such as longlines and handlines tends to be more selective if the size of the hook is adjusted and the size of the fish caught meets the criteria for the fishing ground (Bramana *et al.* 2018). Overfishing of individuals who have not reached a suitable catch size can be a serious threat to the sustainability of fish populations, especially yellowfin tuna (Jaya *et al.* 2018; Eighani *et al.* 2021; Zhang *et al.* 2021). The suitable catch size, which is usually determined based on the length of the fish when it first matures, is an important factor in sustainable fisheries management. If fish are caught before reaching this size, reproductive opportunities are reduced, the biomass of fish stocks decreases, and the risk of growth overfishing increases (Simbolon 2010; Zainuddin *et al.* 2021).

Fishing pressure must be adjusted to the proportion of fish that have met the criteria for catchable size to maintain the sustainability of tuna resources. This approach can ensure that population regeneration is maintained, marine ecosystems remain balanced, and fish stocks are available for long-term use. Fisheries management based on catchable size is an important step in balancing optimal fishing activities with the preservation of yellowfin tuna resources in the waters of West Sumatra.

The catchable size is a key parameter in sustainable fisheries management. The ideal catch size is closely related to the maturity of the first gonad (Sarianto *et al.* 2016; Muharam *et al.* 2020; Widiyastuti *et al.* 2021). In yellowfin tuna, this size ranges from 60 to 80 cm fork length. If fish are caught before reaching this size, the opportunity for reproduction will be reduced, leading to decreased biomass and population regeneration (Davies *et al.* 2014; Taurusman *et al.* 2021; Syadli *et al.* 2022). Fish composition also provides an important picture of population structure, including the proportion of small fish (juveniles) and adult fish. The proportion of catches dominated by small fish indicates the risk of growth overfishing, which is catching fish before they reach the optimal size for growth (Gough *et al.* 2020; Yuwandana *et al.* 2023).

In addition to the composition of yellowfin tuna, analysis of fish growth patterns also needs to be carried out. Knowing the growth pattern of yellowfin tuna is an important step in understanding the first mature gonad size, which is the size at which the fish are first able to reproduce. Fish growth can be isometric, where the increase in length and weight is balanced, or allometric, where the length and weight increase disproportionately, either positively or negatively (Jusmaldi *et al.* 2021; Zulfahmi *et al.* 2024). Previous studies have shown that environmental factors, such as water temperature, food availability, and fishing pressure, also affect variations in yellowfin tuna growth patterns in various locations (Matsumoto *et al.* 2020; Pacicco *et al.* 2021; Li *et al.* 2024). Therefore, studies on the distribution of length and length-weight relationships of yellowfin tuna are very important for evaluating the status of fish populations and supporting sustainable fisheries management in the waters of West Sumatra.

Management of tuna fishery resources, especially yellowfin tuna (*T. albacares*), requires a scientific data-based approach, especially in determining the catchable size limit that is by following per under local population dynamics and ecosystems. One approach that is widely used in sustainable management is the use of the first gonad maturity size parameter as a reference for the catchable size. However, in reality, fishing activities in various regions of Indonesia, including the waters of West Sumatra, are still dominated by small catches that have not reached the gonad maturity length, which indicates that growth overfishing practices are still occurring (Davies *et al.* 2014; Syadli *et al.* 2022; Gough *et al.* 2020).

However, until now, there are still

limited studies that specifically analyze the size distribution of yellowfin tuna in the waters of West Sumatra, especially during the east season, by referring to the size of the first gonad maturity as an indicator of catchability. Several studies, such as those conducted by Pilling *et al.* (2016) and Gough *et al.* (2020), have emphasized the importance of monitoring fish size as a basis for tuna stock management in the Pacific and Indian Oceans. Meanwhile, local studies such as those conducted by Zainuddin *et al.* (2021) and Syadli *et al.* (2022) state that the proportion of fish below catchable size is still quite high in Indonesia's main fishing areas, including West Sumatra.

Therefore, the problems raised in this study are the distribution of the length size of yellowfin tuna caught during the east season in the waters of West Sumatra, the growth pattern of yellowfin tuna (based on the length-weight relationship), and the proportion of fish that have reached a catchable size based on the first gonad maturity length. These problems need to be answered to assess the risk of growth overfishing and support a minimum catch size-based management strategy as a form of sustainable fisheries conservation (Davies *et al.* 2014; Pacicco *et al.* 2021; Li *et al.* 2024).

This study aims to determine the distribution of fish length and fish growth patterns and determine the level of catchability of yellowfin tuna during the east season in the waters of West Sumatra. The results of this study are expected to provide information on the proportion of fish that have reached a catchable size based on the length of the first gonad maturity. This is important to support the sustainability of the yellowfin tuna population through appropriate fishing practices, maintaining opportunities for natural regeneration of the population, and reducing the risk of growth overfishing (Simbolon 2010; Pilling *et al.* 2016; Kumasi *et al.* 2018; Gough *et al.* 2020).

METHODS

Time and location

This research was conducted during the east season, namely from June to August 2020, at the Bungus Ocean Fishing Port, West Sumatra Province. This location is one of the main landing points for yellowfin tuna catches and is an important representation in describing the condition of tuna fisheries in the waters of West Sumatra.

Types of research and approaches

This research is a survey research with a case study conducted in the waters of West Sumatra, especially in the Bungus Ocean Fishing Port. The case study was chosen to describe the actual conditions of yellowfin tuna fisheries in this area as a representation of the main fishing and landing locations in West Sumatra. The approach used was a descriptive quantitative approach, with direct observation techniques on tuna caught by fishermen. The purpose of this approach is to systematically describe the distribution of fish sizes, growth patterns, and the proportion of fish that meet or have not met the size that is suitable for capture based on data measured directly.

Tools and materials

The tools used in this study were a laptop with a Windows operating system equipped with Microsoft Excel 2019 and ArcGIS 10.8 software. Microsoft Excel 2019 was used to analyze the relationship between the length and weight of yellowfin tuna (*T. albacares*) through statistical calculations and graphing. ArcGIS 10.8 was used to create a map of the research location showing the geographical distribution of fishing locations. The research materials consisted of yellowfin tuna fishing data for the eastern season of 2020, which included the length (cm) and weight (kg) of the fish.

Method of collecting data

Fork length (FL) and weight data of yellowfin tuna (*T. albacares*) were collected through direct measurements at the Bungus Ocean Fishing Port, West Sumatra (Figure 1). Fish length measurements were taken from the tip of the upper mouth to the tip of the tailbone using a tape measurement with a maximum length of 5 m, while fish weight was measured using a digital scale with a maximum capacity of 150 kg. All yellowfin tuna landed at the research location were systematically measured for length and weight to ensure accurate and representative data. This study applied a direct observation method with a total sampling approach, which means that all yellowfin tuna landed during the study became the object of measurement. The measurement results were recorded in detail on a fish biology worksheet as the main material for analysis.

Parameters analyzed

This research focused on several main parameters related to the biological aspects of yellowfin tuna (*T. albacares*) and the sustainability of fishery resources, namely:

1. Fork Length to assess population structure, growth stage, and suitability of fish catch size.
2. Body Weight is used to evaluate the physiological condition of the fish and is one of the indicators of catchability, along with length.
3. Length and Weight Relationship describes the growth pattern of fish and is used to determine whether the fish experiences isometric (balanced) or allometric (unbalanced) growth, either positive or negative.
4. Proportion of Catchability to measure the percentage of fish that meet the minimum catch size based on biological length and weight standards (length ≥90 cm and weight ≥30 kg), and determine the sustainability of the fishing pattern carried out.
5. The value of the regression coefficient (a and b), the coefficient of determination (R^2), and correlation (r) as indicators of the strength and growth pattern of fish.

Data analysis

Analysis of fish length and weight distribution

Fish length and weight data were analyzed descriptively to see the distribution of fish population sizes caught during the study period. The results were displayed in the form of distribution graphs based on months and size ranges.

Fish growth pattern analysis

Analysis of the relationship between the length and weight of fish is one of the most important approaches in the study of fisheries biology because it can be used to understand the growth patterns, physical conditions, and health of a fish species in an ecosystem. This relationship was first introduced by Cren (1951), who stated that the relationship between the length and weight of fish can be expressed in the form of an exponential equation:

$$W = aL^b$$

Description:
W = Fish weight (kg)
L = Fish length (cm)
a and b = Regression constant and growth exponent.

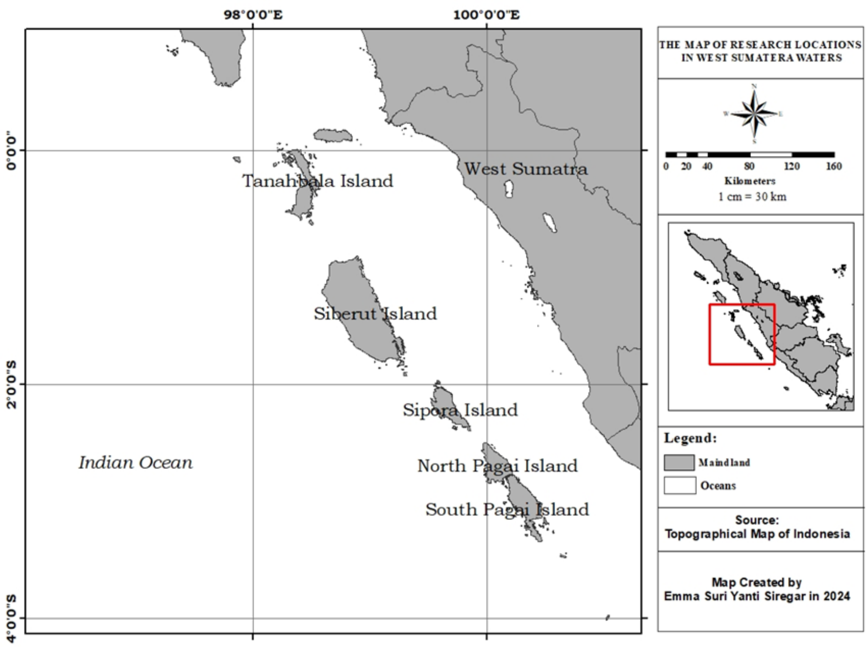


Figure 1. Research location in the waters of West Sumatra.

The equation was transformed into a natural logarithm (Ln) by Cren (1951) to simplify data analysis and change the exponential relationship into a linear form. This transformation produces the equation:

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

Description:
W = Fish weight (kg)
L = Fish length (cm)
A = Intersection point of the regression line with the Y axis (intercept)
B = Tangent of the regression line angle (growth coefficient)

Through logarithmic transformation, the relationship between fish length and weight can be analyzed using simple linear regression, where Ln W serves as the dependent variable (Y) and Ln L as the independent variable (X). In this equation, the value of a represents the intercept or starting point of the regression line on the Y-axis, while b shows the slope of the regression line that describes the growth pattern of fish. This transformation changes the complex exponential relationship into a linear form, thus simplifying the process of data analysis and interpretation.

The exponent value b is the main parameter that determines the type of fish growth. If the value of b = 3, then the fish growth is categorized as isometric, meaning that the increase in length and weight occurs in a balanced manner. If b > 3, the growth is positive allometric, where the weight of the fish increases faster than its length, while b < 3 indicates negative allometric, where the length increases faster than the weight (Kohler *et al.* 2021).

Fish length measurements were taken from the tip of the upper mouth to the tip of the tailbone using a tape measure (with a maximum length of 5 m), while fish weight was measured using a digital scale with a capacity of up to 150 kg. All yellowfin tuna (*T. albacares*) landed at the research location were systematically measured for length and weight, and the results were recorded in a fish biology worksheet (Satria *et al.* 2019). The collected fish length and weight data were analyzed using linear regression after a logarithmic transformation was performed on the equation to log W = log a + b log L (Cren 1951). This analysis was carried out using Microsoft Excel 2019 software to facilitate the calculation of the regression coefficient and determination (R^2) to assess the strength of the relationship between fish length and weight. In addition, the data were visualized in the form of a scatter plot with a regression line that illustrates the trend of the relationship.

The results of this analysis are important for evaluating the condition of tuna fish populations, such as growth patterns and factors that influence them, such as food availability and aquatic environmental conditions. These data also provide a scientific basis to support sustainable fisheries management policies and conservation efforts for yellowfin tuna stocks to remain sustainable in their natural habitat (Pauly and Zeller 2020).

Catchability analysis

The catchability of fish is determined based on the criteria of length ≥90 cm and weight ≥30 kg, referring to the first gonad maturity size from previous studies (Zainuddin *et al.* 2021; Farley *et al.* 2013). The proportion of fish that meet or have not met these criteria was calculated as a percentage to evaluate the extent to which the catch is by following per under the principles of sustainable.

RESULTS AND DISCUSSION

Distribution of fish length and weight
The number of tuna fish (*T. albacares*) that were successfully measured reached 398 individuals. The number of fish whose fork length and weight were successfully measured during the period of June-August 2020 showed variations in number and size each month (Figure 2). The results of data analysis showed that the fork length of the most dominant fish caught was in the range of 135-144 cm, with a weight of 44-60 kg. In terms of fish size, the minimum length of fish recorded was 90 cm, and the maximum length reached 180 cm. The minimum weight was 12 kg, and the maximum weight reached 92 kg. The average fork length of the fish during this period was around 138 cm, and a weight of 47 kg, which reflects the general size and weight of the population caught.

In June, 42 individuals were successfully measured, with the dominant length in the range of 128-142 cm and a weight of 35-40 kg. The shortest length recorded was 100 cm with a weight of 17 kg, while the maximum length reached 170 cm and a weight of 79 kg, with an average length of 140 cm and a weight of 50 kg (Figure 3). In July, the number of fish measured increased significantly to 216 individuals. The dominant length range recorded was between 130 and 150 cm, with a weight of 50-60 kg. The shortest length was 90 cm with a weight of 12 kg, and the maximum length reached 178 cm with a weight of 89 kg (Figure 4). The average length of the fish this month was still at 140 cm, showing a stable trend compared to the previous month. Meanwhile, in August, 140 individuals were successfully measured, with the dominant length ranging from 125 to 143 cm, with a weight of 40 to 50 kg (Figure 5). The minimum length recorded was 90 cm with a weight of 15 kg, while the maximum length was 180 cm with a weight of 80 kg. Compared to the results of previous research conducted by Nugroho *et al.* (2020), the length of yellowfin tuna in the Indian Ocean ranged from 30 to 179 cm, with an average length reaching 101.65 cm (Satria *et al.* 2019). The difference in results can be influenced by several factors, such as the location of the catch, the condition of the aquatic environment, the availability of food, and the fishing equipment and methods used. The higher average length of tuna in this study, especially from June to August, indicates the dominance of medium-to adult-sized individuals in the catch.

The distribution pattern of length and weight of these fish provides important information about the population structure of yellowfin tuna in the waters of West Sumatra. The increase in the number of fish in July may indicate the peak of the fishing season, which allows fishermen to catch more individuals. The decrease in the average length in August may indicate an increase in the capture of smaller individuals, which could have an impact on the sustainability of fish stocks in the future if not managed properly. Therefore, this information can be the basis for supporting more sustainable fisheries resource management to maintain the yellowfin tuna population in these waters.

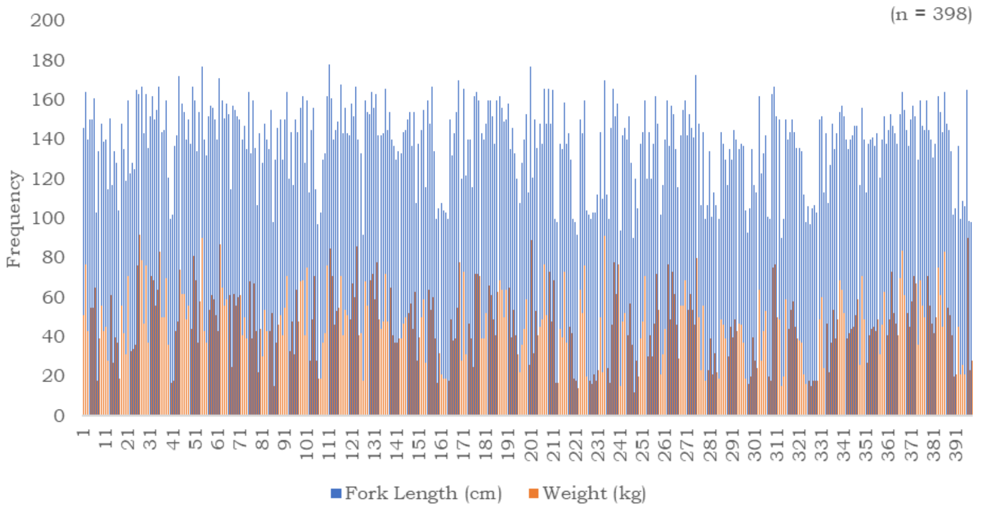
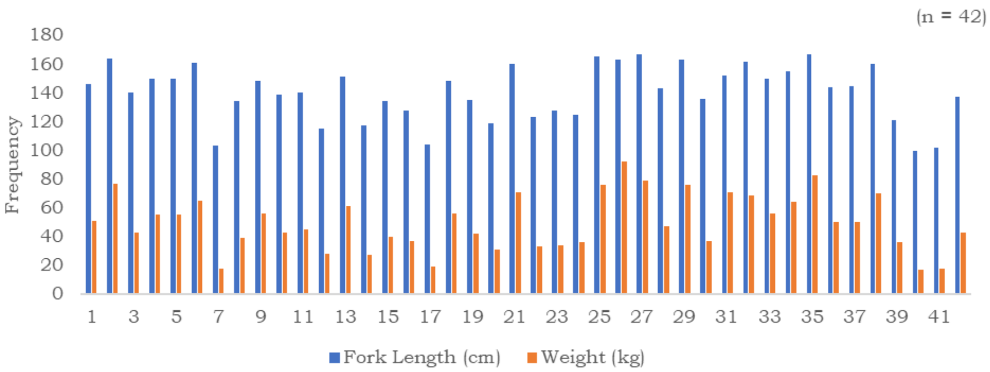


Figure 2. Distribution of length and weight of yellowfin tuna in the eastern season.



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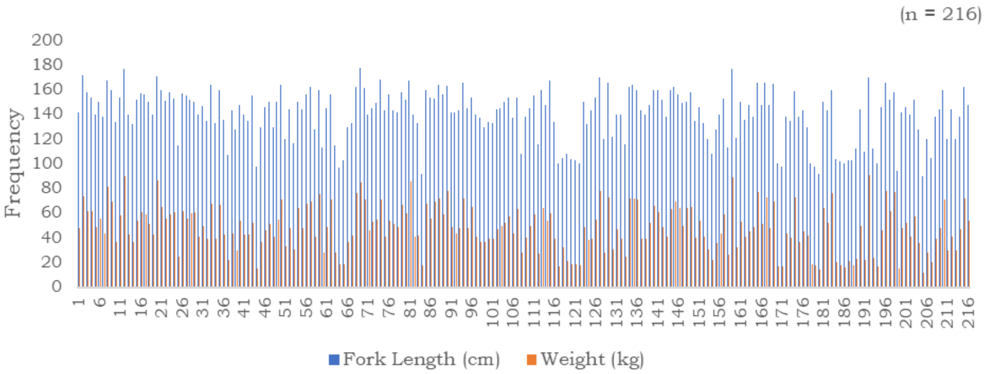

Figure 4. Distribution of length and weight of yellowfin tuna in July.

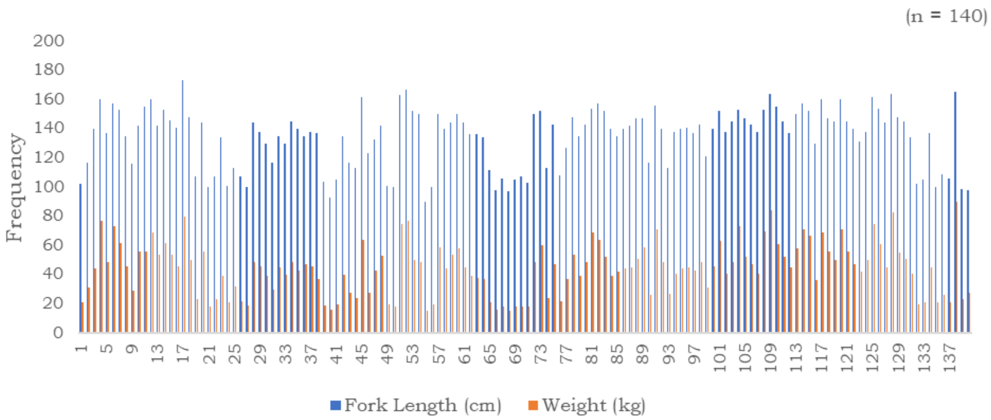

Figure 5. Distribution of length and weight of yellowfin tuna in August.

Fish growth patterns

Fish growth patterns can be analyzed through the relationship between the length and weight of yellowfin tuna (*T. albacares*), which produces a regression equation $y = 0.00005x^{2.7787}$ with $R^2 = 0.9575$, r = 0.978519, and b = 2.4969 (Figure 6). A b value smaller than 3 indicates a negative allometric growth pattern, where the growth in fish length is more dominant than the growth in weight. A negative allometric growth pattern occurs when the increase in fish length is more dominant than the increase in weight. This condition indicates that yellowfin tuna tend to allocate more energy to body length growth compared to increasing body mass. This phenomenon is commonly found in large pelagic fish that live in open waters, where a slender and long body shape provides advantages in swimming speed and energy efficiency for foraging or migrating (Froese 2006).

Meanwhile, the R^2 value = 0.9575 indicates that 95.75% of the variation in fish weight can be explained by the length of the fish, while the rest is influenced by other factors not included in the regression model. The r value = 0.978519, which is close to 1, indicates a very strong relationship between fish length and weight. A high R^2 value reflects that the linear regression model used has a very good ability to predict fish weight based on its length. This indicates that fish length is the main factor affecting its weight. However, an R^2 value of less than 1 also indicates the influence of other factors, such as individual variation, physiological conditions, and environmental dynamics, including food availability and habitat conditions. The r value = 0.978519 indicates that the relationship between fish length and weight is almost perfect. This very strong correlation indicates that the longer the fish's body, the more its weight will increase consistently according to the pattern found. However, even though the r value is high, there is still variability that is not fully explained, which is likely caused by genetic factors, fish reproductive conditions, or local ecosystem variations.

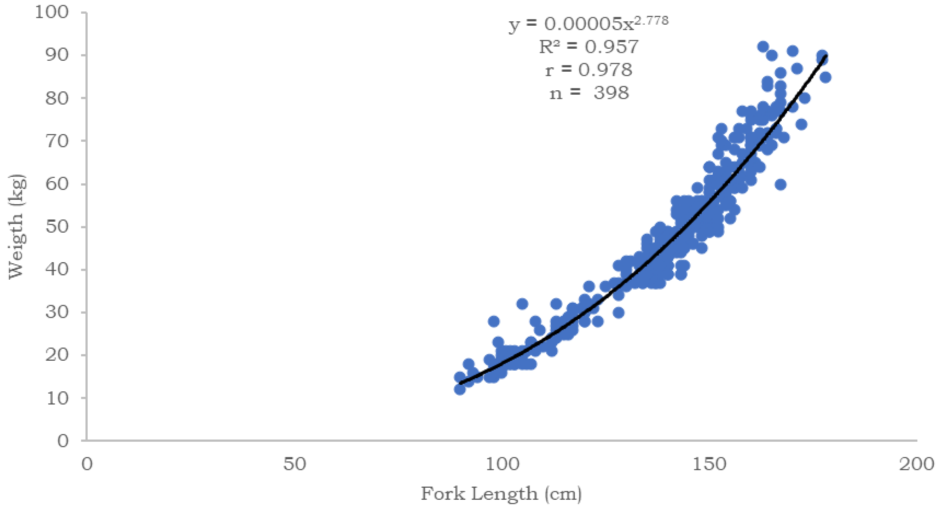

Figure 6. Graph of the relationship between length and weight of yellowfin tuna.

Similar studies support these findings. Schaefer (2001) reported a strong relationship between the length and weight of yellowfin tuna in the Pacific Ocean, with a correlation value approaching perfect. Nugroho *et al.* (2020) in the Indian Ocean also found a similar linear relationship pattern with an R^2 value of around 0.95, indicating consistency between length and weight in tuna populations in tropical regions. Farley *et al.* (2013) in the West Pacific noted a similar growth pattern with an R^2 value of more than 0.90, confirming that fish length is the main predictor of yellowfin tuna weight. Zainuddin *et al.* (2021) also reported a consistent relationship pattern in the waters of West Sumatra. This very strong linear relationship provides an important scientific basis for understanding the condition of the yellowfin tuna population in the waters of West Sumatra. With this data, fisheries management can be focused on efforts to conserve tuna stocks, as well as supporting the sustainability of marine ecosystems. High R^2 and r values indicate that the regression model is reliable for analyzing the relationship between fish length and weight while providing relevant information for scientific data-based management.

Catchable size and sustainability level of fish

The catchable size of yellowfin tuna (*T. albacares*) is closely related to the length at first maturity (L_m), which is the size of the fish when it is first sexually mature and can reproduce. According to Froese (2004), this size is a reference in fisheries management to ensure that fish have the opportunity to breed before being caught, so that the population stock can be maintained.

In determining the suitability of fishing, fish weight is also an important indicator because it reflects their health and reproductive ability. Fish with a lighter weight may not have enough energy reserves to support the spawning process, especially if they are lighter weight, even though their body length has met the catchable size. Fishing in this condition can not only reduce the economic value of the catch but also has the potential to disrupt population regeneration, especially if lightweight is a sign of wider environmental disturbances (Agustina *et al.* 2020).

Research in the Indian Ocean waters reported that the first gonad maturity size of yellowfin tuna varies but is generally around 90-100 cm fork length with a weight of around 30-40 kg (Davies *et al.* 2014; Nugroho *et al.* 2020). The results of another study by Zainuddin *et al.* (2021) showed that yellowfin tuna individuals in this region reach sexual maturity at a length of around 95 cm with a weight of around 35 kg. Meanwhile, a study by Farley *et al.* (2013) also noted that the first gonad maturity size ranged from 93 to 103 cm with a weight of 32 to 42 kg in the tropical waters of the Indian Ocean. This size shows that yellowfin tuna in this region has relatively similar growth and development rates to other tropical waters.

Environmental factors such as water temperature, feed productivity, and fishing pressure can affect the size of the first gonad maturity. High fishing pressure often leads to the phenomenon of size selection, where fish reproduce at smaller sizes in response to overfishing (Law 2000). Comparison with studies in other regions shows significant differences. For example, in Indonesian waters, Satria *et al.* (2019) reported that the size of the first gonad maturity of yellowfin tuna was lower, ranging from 60-80 cm with a weight of around 15 to 25 kg. Meanwhile, research in the Pacific Ocean conducted by Schaefer (2001) found the size of the first gonad maturity ranged from 95 to 105 cm, with a weight of around 30 to 45 kg. This difference shows the importance of determining the minimum catch size that takes into account local specifications, such as environmental conditions and population stock dynamics in each region. Previous research, especially that conducted by Zainuddin *et al.* (2021), became the basis for determining the minimum catch size for yellowfin tuna in the waters of West Sumatra, namely >90 cm with a weight of >30 kg.

The results of the tuna catch eligibility analysis based on size and weight showed that all tuna caught had met the criteria for being catchable, namely having a length above the recommended minimum limit (>90 cm). The individuals measured numbered 398, all of which were classified as catchable, but based on their weight, 77 fish were classified as unsuitable for catch because they weighed <30 kg. Protection of fish below 30 kg is needed to support population regeneration, while fish in the weight class above 30 kg can be considered as parent stock for population preservation. This weight-based fisheries management is important to maintain a balance between population sustainability and catch sustainability.

The results of this study indicate that 81% of the fish meet the criteria for being suitable for fishing, while the other 19% are classified as not suitable for fishing (Figure 7). This shows that most of the fish caught are in accordance with the established size and weight standards, although there are still a small number of fish that do not meet these criteria. These findings indicate that fishermen in the waters of West Sumatra need to implement responsible fishing practices to maintain the sustainability of marine resources and ecosystem balance. Fishermen in the waters of West Sumatra generally use tuna longline fishing gear and handlines. Both of these tools are classified as quite selective, especially when the size of the hook is adjusted. However, in practice in the field, especially during the abundant fishing season, the operation of fishing gear often does not pay strict attention to selectivity. This can occur due to economic incentives to increase catches in a short time or a lack of supervision of the use of technical standards for environmentally friendly fishing gear.

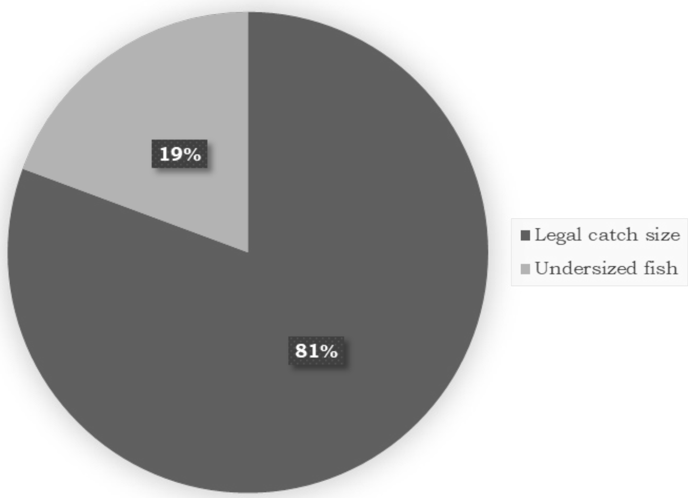

Figure 7. Proportion of catch eligibility of yellowfin tuna.

One of the main actions that needs to be taken is to ensure that the fish caught have reached the first gonad maturity size, which is the phase where the fish can reproduce to support population regeneration. In addition, catching fish weighing at least 30 kg is an important step to ensure that the fish have reached the optimal size so that the population remains stable and undisturbed. The implementation of this catchable size not only contributes to the preservation of the marine environment but is also the key to the economic sustainability of fishermen in the future. By limiting the catch to fish that meet these criteria, the risk of overfishing can be reduced so that the availability of fish stocks is maintained in the long term. This strategy is in line with the principles of sustainable fisheries management, which prioritize economic, social, and ecological benefits in a balanced manner. The successful implementation of this regulation requires cooperation from various parties, including the government, environmental organizations, and the community, to provide education, support, and supervision of responsible fishing practices.

CONCLUSION

The results of the study showed that yellowfin tuna caught in the waters of West Sumatra during the 2020 eastern season were dominated by fish measuring 135-144 cm long and weighing 44-60 kg, with an average length of 138 cm and weighing 47 kg. The growth pattern showed negative allometric characteristics, indicating that length growth was more dominant than weight growth. The results of this study showed that 81% of fish met the criteria for being suitable for fishing based on body length and weight, while 19% were classified as not yet suitable for fishing. These findings serve as a reference for fishermen in the waters of West Sumatra to implement responsible fishing practices in order to maintain the sustainability of marine resources and ecosystem balance.

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