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Size Structure and Catch of Yellowfin Tuna (Thunnus albacares) Landed in Sumare Village, Mamuju Regency

Hasbiana Anwar[1], Femiliani Novitasari[2], Widya Utami[3]
Universitas Muhammadiyah Mamuju
Corresponding Author: Femiliani Novitasari femiliani@unimaju.ac.id

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A B S T R A C T

Yellowfin tuna (Thunnus albacares) is a high-economic-value fishery commodity and the main target of handline fishers in Sumare Village, Mamuju Regency, West Sulawesi. This study aims to analyze the size structure, length-weight relationship, and catch production of yellowfin tuna landed in Sumare Village. Sampling was conducted from January to February 2026 using a purposive sampling method on two handline fishing vessels, with a total of 30 fishing trips and 350 fish samples. For each individual fish, standard length (SL), fork length (FL), total length (TL), and body weight were measured. The results showed a total production of 25,466.0 kg from 350 fish during 30 trips. Fork length ranged from 95 to 165 cm FL with an average of 141.1 ± 20.0 cm, and weight ranged from 13.5 to 129.9 kg with an average of 72.8 ± 33.0 kg. The size distribution was dominated by the 150-165 cm FL class (50.0%) and the ≥ 100 kg weight class (26.0%). The length-weight relationship produced the equation $W = 3.57 \times 10^{-7} \times L^{3.8453}$ (R^2 = 0.9784; b = 3.8453; calculated t = 27.60 > table t = 1.967), indicating a positive allometric growth pattern. A total of 96.3% of the fish (337 of 350 individuals) exceeded the catchable size (FL ≥ 100 cm).

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INTRODUCTION

Mamuju Regency, located in West Sulawesi Province, has more than 500 km of coastline stretching along Mandar Bay. These waters are a natural habitat for various high-economic-value fish species, including yellowfin tuna (Thunnus albacares). Sumare Village, located on the coast of Mamuju Regency and directly bordering the Makassar Strait, is one of the tuna landing centers in the region (Roswati, 2023). Yellowfin tuna (Thunnus albacares) is one of the high-economic-value fishery commodities that serves as the main target of fishers in Sumare Village. This fish is pelagic-oceanic, forms schools beneath the water surface to depths of up to 100 meters (Barata et al., 2011), and is caught using handline fishing gear. In addition to its high economic value, yellowfin tuna also plays an important role in maintaining the balance of marine ecosystems as a high-level predator. High market demand for tuna has increased fishing activity, which can affect population dynamics and stock sustainability if not accompanied by management based on scientific data. According to data from the Ministry of Marine Affairs and Fisheries of the Republic of Indonesia (KKP RI, 2024), the volume of tuna production landed in Sumare Village fluctuated from 727.21 tons in 2020 to 2,944.68 tons in 2023, before declining to 1,610.99 tons in 2024. These production fluctuations may be influenced by various factors, such as changes in fishing intensity, oceanographic conditions, fishing season, stock availability, and the efficiency of the fishing gear used. A decline in production in certain periods may serve as an early indication of changes in fishery productivity that require further evaluation through biological and fisheries approaches.

A study of fish size structure is important because it can describe the condition of fish stocks and their level of exploitation. The size distribution of catches can be used to identify the dominance of certain size groups and provide information on fishing pressure on fish populations. Meanwhile, the length-weight relationship is an indicator of fish growth pattern and biological condition, while catch production is used to describe changes in the relative abundance of resources over time. Agatis et al. (2025), in a study in West Sumatra waters, reported that landed yellowfin tuna were dominated by fish measuring 135-144 cm and weighing 44-60 kg, with 81% of fish having met the catchable size. Agustina (2024), at Prigi Archipelagic Fishing Port, reported a length range of 21-172 cm FL with negative allometric growth. Kantun et al. (2018), in the Makassar Strait, showed that the distribution of fish length was influenced by fishing location and fishing intensity. Although many studies on the biological aspects and catches of yellowfin tuna have been carried out in various regions of Indonesia, studies that integrate size distribution, length-weight relationship, and catch production at the Sumare Village landing site remain very limited. Most previous studies focused only on one biological parameter or were conducted at a broader regional scale, so they have not been able to describe the actual condition of tuna resources landed by handline fishers in Mamuju Regency. Therefore, the novelty of this study lies in its integrated analysis of catch size structure, length-weight relationship, and catch production based on actual landing data to generate site-specific information that can be used as a

basis for evaluating the sustainable yellowfin tuna fishery in the Mandar Bay area.

METHODOLOGY

Time and Location of the Study

This study was conducted from January to February 2026 in Sumare Village, Simboro District, Mamuju Regency, West Sulawesi. The research location is a tuna landing site actively used by local handline fishers.

Data Collection

Yellowfin tuna samples were obtained using a purposive sampling method, namely by collecting samples from two handline fishing vessels selected based on the following criteria: the vessels were actively operating during the study period, used handline fishing gear, and landed their catches at the research location. Observations were conducted over a total of 30 fishing trips. For each individual fish, standard length (SL), fork length (FL), and total length (TL) were measured using a measuring board/ruler (cm), while body weight was measured using a scale (kg). Monthly production data were obtained from the Marine Affairs and Fisheries Office (DKP) of Mamuju Regency and the local Fish Landing Site (TPI).

Data Analysis

Length-frequency distribution was presented in tabular form based on fork length (FL) classes. The length-weight relationship was analyzed using the Le Cren (1951) equation:

$$W = a \times L^b$$

Where W is total weight (kg), L is fork length (cm), and a and b are constants. The equation was transformed into logarithmic form ($\log W = \log a + b \log L$) and analyzed using linear regression. Growth patterns were determined based on the b value: isometric ($b = 3$), positive allometric ($b > 3$), or negative allometric ($b < 3$), which was tested using a t-test at the 95% confidence interval (Zar, 1984). Catchable size refers to the length at first gonadal maturity (Lm), namely FL ≥ 100 cm (Nugroho et al., 2018).

RESEARCH RESULT

Catch Production of Yellowfin Tuna (Thunnus albacares)

The production of yellowfin tuna (Thunnus albacares) catches during the study took place from January to February 2026 in Sumare Village, Mamuju Regency. Data collection was carried out over 30 fishing trips using two handline fishing vessels, with total production reaching 25,466.0 kg from 350 fish. The average production per trip was 848.9 kg, with an average of 11.7 fish per trip and an average body weight of 72.8 kg per fish. Complete production data by trip are presented in Table 1 and the monthly summary is presented in Table 1.

Table 1. Production Data of Yellowfin Tuna Catches per Fishing Trip in Sumare Village

Trip No.	Production (kg)	Number (fish)	Average Weight/Fish (kg)
1	631,7	9	70,2
2	642,4	9	71,4
3	740,9	10	74,1
4	648,7	9	72,1
5	893,0	12	74,4
6	935,0	13	71,9
7	1088,4	15	72,6
8	1025,6	14	73,3
9	**1185,6**	**16**	**74,1**
10	972,5	13	74,8
11	822,0	11	74,7
12	820,8	11	74,6
13	793,5	11	72,1
14	718,7	10	71,9
15	852,4	12	71,0
16	647,0	9	71,9
17	830,2	11	75,5
18	640,7	9	71,2
19	728,8	10	72,9
20	776,5	11	70,6
21	1099,4	15	73,3
22	849,3	12	70,8
23	864,5	12	72,0
24	1063,9	15	70,9
25	827,3	11	75,2
26	947,2	13	72,9
27	843,3	12	70,3
28	748,5	10	74,8
29	924,8	13	71,1
30	903,4	12	75,3
Total/Average	**25.466,0**	**350**	**72,8**

Based on Table 1, there were fairly clear fluctuations in production among trips. The highest production was achieved on the 9th trip (January), at 1,185.6 kg with 16 fish, while the lowest production occurred on the 1st trip, at 631.7 kg with 9 fish. The difference between the highest and lowest production reached 553.9 kg (87.7%), indicating substantial variability in catches among fishing trips. The pattern of daily production fluctuation was strongly influenced by several main factors. First, changing weather and ocean current conditions during the transitional season in January-February affected fishers' ability to determine the appropriate fishing grounds. Second, the migratory schooling behavior of tuna caused fish presence in a given location to vary from day to day. Third, fishers'

skills and experience in reading water conditions and determining the time and location for setting handlines also contributed to differences in catches among trips (Kantun & Mallawa, 2016).

Low-production trips (trips 1, 2, 4, 16, and 18), ranging from 631.7 to 648.7 kg, were likely caused by unfavorable weather conditions or by fishers still exploring fishing locations. Early fishing trips generally produce lower catches because fishers need time to find suitable fish schools. Nevertheless, even the lowest production value (631.7 kg/trip) still reflects a significant catch for small-scale handline fisheries in Sumare Village. Overall, the average production of 848.9 kg/trip and total production of 25,466.0 kg over 30 trips indicate high productivity of the tuna fishery in the waters of Sumare Village. This value is much higher than the national average for small-scale handline fisheries, which generally ranges from 200 to 500 kg/trip (KKP RI, 2024), indicating that the Makassar Strait waters around Sumare Village are highly productive fishing grounds for yellowfin tuna. This high productivity needs to be maintained through prudent management to prevent overfishing, which could significantly reduce production as seen in the decline in annual production in 2024 (KKP RI, 2024).

Length Frequency Distribution

Based on measurements of 350 yellowfin tuna landed from 30 fishing trips, the fork length (FL) ranged from 95 to 165 cm, with an average of 141.1 ± 20.0 cm. Standard length (SL) ranged from 85 to 152 cm with an average of 127.2 cm, while total length (TL) ranged from 110 to 195 cm with an average of 166.7 cm. The fork length distribution is presented in Table 2.

Table 2. Fork Length Frequency Distribution of Yellowfin Tuna Landed in Sumare Village

Length Class (FL, cm)	Number (fish)	Percentage (%)
95 - < 110	35	10,0
110 - < 130	70	20,0
130 - < 150	70	20,0
150 - < 165	175	50,0
Total	350	100,0

Source: Research analysis results

The size distribution showed dominance of fish in the 150-165 cm FL length class (175 fish; 50.0%), followed by the 110-130 cm class (70 fish; 20.0%) and the 130-150 cm class (70 fish; 20.0%), while the smallest class, 95-110 cm, comprised 35 fish (10.0%). These results indicate that tuna landed in Sumare Village were generally large. This is consistent with the study by Kantun et al. (2018) in the Makassar Strait, which reported the dominance of large fish in handline fisheries, where this fishing gear tends to be selective for larger fish. The larger length range compared with several other locations, such as Prigi (21-172 cm FL; Agustina, 2024), may reflect the characteristics of the fishing ground and

the selectivity of fishing gear in the Makassar Strait, which is a major migration route for adult tuna.

Weight Frequency Distribution per Fish

Weight measurements of 350 yellowfin tuna landed in Sumare Village showed a weight range of 13.5-129.9 kg, with an average of 72.8 ± 33.0 kg and a median of 80.7 kg. The weight frequency distribution per fish is presented in Table 3. Based on Table 3, the weight distribution was divided into six classes with an uneven pattern. The ≥ 100 kg weight class dominated with the highest number, namely 91 fish (26.0%), followed by the 80-<100 kg class with 86 fish (24.6%).

Cumulatively, the data showed that up to the 60-<80 kg weight class, only 49.4% of fish were included, meaning that more than half of the fish (50.6%) weighed above 80 kg. This further confirms the dominance of large fish in the catches landed in Sumare Village. This condition is closely related to the selectivity of the handline fishing gear used by local fishers. Handlines with large live bait naturally attract larger adult fish, so small and juvenile fish are relatively rarely caught (Sudirman, 2020). The weight distribution skewed toward high-weight classes is also closely related to the fork length distribution discussed previously, in which 50% of samples were in the 150-165 cm FL class. Fish in this length class had an average weight of 100.6 kg, so it is reasonable that the ≥ 100 kg weight class dominated the weight frequency distribution. This is consistent with the positive allometric growth pattern (b = 3.8453) obtained from the length-weight relationship analysis, in which weight increase occurs faster than length increase as fish size increases.

The dominance of large fish in the catches landed in Sumare Village has positive implications for resource sustainability. Fish weighing ≥ 80 kg generally exceed the length at first gonadal maturity (FL ≥ 100 cm; Nugroho et al., 2018), so they are assumed to have contributed to population reproduction before being caught. This result is in line with the findings of Kantun et al. (2018), who stated that handline fisheries in the Makassar Strait tend to catch large adult tuna in optimal physiological condition, with a relative condition factor (Kn) close to 1.000, indicating a balance between fish body length and weight under supportive environmental conditions.

Table 3. Weight frequency distribution per individual yellowfin tuna landed in Sumare Village (n = 350)

Weight Class (kg)	Number (fish)	Percentage (%)	Cumulative (fish)	Cumulative (%)
< 20	20	5,7	20	5,7
20 – < 40	64	18,3	84	24,0

Weight Class (kg)	Number (fish)	Percentage (%)	Cumulative (fish)	Cumulative (%)
40 – < 60	44	12,6	128	36,6
60 – < 80	45	12,9	173	49,4
80 – < 100	86	24,6	259	74,0
≥ 100	91	26,0	350	100,0
Total	**350**	**100,0**	—	—

Source: Research analysis results

Length-Weight Relationship

The analysis of the length-weight relationship using fork length (FL) as the length variable produced the equation: $W = 3.57 \times 10^{-7} \times L^{3.8453}$ ($R^2 = 0.9784$). The coefficient of determination (R^2) of 0.9784 indicates that 97.84% of the variation in fish weight can be explained by variation in fork length, so this equation has a very high level of accuracy. The analytical parameters are presented in Table 4.

Table 4. Parameters of the Length-Weight Relationship of Yellowfin Tuna in Sumare Village

Parameter	Value
Number of samples (n)	350 fish
FL range (cm)	95 - 165
Average FL (cm)	141,1
Weight range (kg)	14 - 130
Average weight (kg)	72,8
Constant a	$3,57 \times 10^{-7}$
Coefficient b	3,8453
Coefficient of determination (R^2)	0,9784
Calculated t value	27,60
Table t value (df=348, α=0.05)	1,967
Growth pattern	Positive Allometric

The b value obtained was 3.8453, which is greater than the theoretical value of b = 3. The t-test results showed that calculated t (27.60) > table t (1.967) at the 95% confidence interval with df = 348, so H0 was rejected and the growth pattern of yellowfin tuna in Sumare Village was concluded to be positive allometric. This means that the increase in fish body weight is faster than the increase in length. A positive allometric pattern indicates that the fish were in good nutritional condition and that the aquatic environment supported biomass accumulation.

This result differs from the studies by Agatis et al. (2025) and Agustina (2024), which reported negative allometric patterns; the difference may be influenced by differences in fishing season, aquatic environmental conditions, and sample size composition.

Positive allometric conditions in large fish (dominant in the FL > 130 cm class) in the Makassar Strait waters may be related to abundant food availability along the tuna migration route. According to Kantun and Mallawa (2016), yellowfin tuna in sufficient feeding conditions tend to show b values approaching or exceeding 3.

Catchable Size

Based on the measurements, 337 of 350 fish (96.3%) had a fork length of ≥ 100 cm, which is the minimum catchable size based on the length at first gonadal maturity (Lm) established by Nugroho et al. (2018). Only 13 fish (3.7%) had FL < 100 cm, and were therefore categorized as below catchable size. The proportion of catchable-size fish, reaching 96.3%, was higher than the report by Agatis et al. (2025) in West Sumatra (81%), indicating that the selectivity of handline gear toward large fish in the waters of Sumare Village is relatively good. Referring to the length at first gonadal maturity according to Kantun et al. (2014), namely FL 104.70 cm, most of the fish caught were far above this threshold. The average FL of the samples, 141.1 cm, indicates that the fish caught were generally gonadally mature and likely had spawned before being caught, which is a positive condition for the sustainability of tuna stocks in the waters of Sumare Village.

CONCLUSIONS AND RECOMMENDATIONS

Based on the research conducted on 350 yellowfin tuna (Thunnus albacares) landed in Sumare Village:

1. Catch production of yellowfin tuna during 30 fishing trips reached a total of 25,466.0 kg from 350 fish, with an average production of 848.9 kg/trip and an average of 11.7 fish/trip. The highest production occurred on the 9th trip (1,185.6 kg/16 fish) and the lowest on the 1st trip (631.7 kg/9 fish). Production fluctuations among trips were influenced by weather conditions, fishing season, tuna migration behavior, and fishers' skills.
2. The size structure of landed yellowfin tuna showed a fork length (FL) range of 95-165 cm with an average of 141.1 ± 20.0 cm, and a weight range of 13.5-129.9 kg with an average of 72.8 ± 33.0 kg. The size distribution was dominated by the 150-165 cm FL class, with 175 fish (50.0%), and the ≥ 100 kg weight class, with 91 fish (26.0%), reflecting the dominance of large adult fish in the catch.
3. The length-weight relationship produced the equation $W = 3.57 \times 10^{-7} \times L^{3.8453}$ ($R^2 = 0.9784$) with a positive allometric growth pattern (b = 3.8453; calculated t 27.60 > table t 1.967; α = 0.05), indicating that fish body weight increased faster than length. This condition reflects the quality of the Makassar Strait aquatic environment, which supports optimal fish biomass accumulation.

A total of 337 of 350 fish (96.3%) had exceeded the catchable size (FL ≥ 100 cm), far above the proportion of catchable fish reported in other locations (81%; Agatis et al., 2025). The very small proportion of fish below catchable size (3.7%) indicates excellent selectivity of handline fishing gear and suggests that most fish caught had contributed to population reproduction.

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