Green Engineering: Journal of Engineering and Applied Science

E-ISSN: 3063-6833
P-ISSN: 3063-6841

Research Article

Length Weight Relationship and Condition Factor of Yellowstripe Scad Selaroides leptolepis in Banda Sea Waters, Morowali

Ahmad Musyali[1], Indri Afriani Yasin[2]*, Talha Dangkua[3], Dewi Shinta Achmad[4], Arfan Tilome[5]

[1-2] Program Studi Magister Manajemen Sumber Daya Hayati, Program Pascasarjana, Universitas Muhammadiyah Gorontalo, Indonesia
[3] Program Studi Akuakultur, Fakultas Sains dan Ilmu Komputer, Indonesia
[4] Program Pascasarjana, Universitas Muhammadiyah Gorontalo, Indonesia
* Corresponding Author: indriyasin@umgo.ac.id

Abstract: Yellowstripe scad (Selaroides leptolepis) is an economically important small pelagic fish that supports coastal livelihoods and local food supply in Morowali, Central Sulawesi. Increasing fishing pressure in Banda Sea waters requires location-specific biological information to guide sustainable management. This study analyzed length-frequency distribution, length-weight relationship, growth pattern, and condition factor of yellowstripe scad landed in Bete-Bete Village, Bahodopi District, Morowali Regency. Sampling was conducted from March to May 2026 using 450 individuals obtained from local fishers, with approximately 150 fish sampled each month. Total length ranged from 138 to 203 mm, and catches were dominated by the 171–190 mm size range, especially the 178–183 mm and 184–190 mm classes. Length-weight relationships showed strong positive associations, with coefficients of determination ranging from 79.88% to 94.79%. Growth was generally isometric across sex and month, except for male fish in March, which showed negative allometric growth. Condition factor values were mostly above 1.0 and generally ranged from approximately 1.0 to 1.4, indicating good physiological condition and sufficient habitat support. The findings indicate that yellowstripe scad in Banda Sea waters around Morowali remain in relatively healthy biological condition. However, precautionary management is still required through minimum catch-size regulation, improved gear selectivity, and routine landing-site monitoring.

Keywords: Condition Factor; Length-Weight Relationship; Selaroides Leptolepis; Small Pelagic Fish; Sustainable Fisheries.

Received: Januari 21, 2026
Revised: Marech 24, 2026
Accepted: May 11, 2026
Online Available: July 21, 2026
Curr. Ver.: July 21, 2026

Copyright: © 2025 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (https://creativecommons.org/licenses/by-sa/4.0/)

1. Introduction

Small pelagic fish are central components of tropical marine ecosystems and coastal economies. Ecologically, they transfer plankton-based production to higher trophic predators and provide forage for many commercially and ecologically valuable marine species (Pikitch et al., 2014; Smith et al., 2011). Socioeconomically, small-scale pelagic fisheries contribute to affordable animal protein, household income, and food security in many coastal communities (Béné, 2006; Funge-Smith & Bennett, 2019). These functions are particularly relevant in eastern Indonesia, where coastal communities rely strongly on nearshore fish resources and small-scale fishing technologies.

Indonesia is the world's largest archipelagic country and has extensive marine fishery potential. One region that contributes substantially to eastern Indonesian fisheries is the Banda Sea, a tropical marine ecosystem with high productivity and biodiversity. In Central Sulawesi, capture fisheries are also important for regional economic activity. Provincial capture production reached 196,143 tons in 2022, and Morowali Regency contributed 33,411 tons, or approximately 17% of the provincial total (Badan Pusat Statistik Provinsi Sulawesi

Tengah, 2022). This contribution indicates that the sustainability of Morowali fisheries is not only an ecological concern but also an economic and social priority.

Morowali Regency is located within Fisheries Management Area WPPNRI 714 and is characterized by small-scale fishing fleets targeting small pelagic fish (Suman et al., 2018). Fishing activity in coastal Morowali is increasingly important because of local market demand, industrial development, and coastal economic growth. These changes can increase anthropogenic pressure on fish stocks, particularly when fishing effort expands without parallel biological monitoring. Excessive exploitation may reduce stock biomass, alter size structure, and weaken reproductive capacity, ultimately reducing the long-term productivity of fisheries (Berkeley et al., 2004).

Yellowstripe scad (Selaroides leptolepis) is one of the economically important small pelagic fish landed by fishers in Morowali. The species is widely consumed, traded in local markets, and valued as a source of animal protein. It is also ecologically relevant because small pelagic fish connect lower trophic organisms with higher-level marine predators. FishBase and FAO species accounts describe S. leptolepis as an Indo-West Pacific small carangid species that inhabits coastal marine waters and reaches a maximum total length of about 22 cm (Food and Agriculture Organization, 2025; Froese & Pauly, 2026).

Production data for scad fish indicate substantial interannual fluctuation. In Central Sulawesi, scad production was recorded at 27,269 tons in 2022, increased to 73,278 tons in 2023, and declined to 41,563 tons in 2024. In Morowali, production increased from 1,344 tons in 2022 to 1,683 tons in 2023 before decreasing to 1,223 tons in 2024 (Kementerian Kelautan dan Perikanan Republik Indonesia, 2024). Such variation does not automatically indicate stock decline because catch can also be influenced by fishing effort, oceanographic conditions, market dynamics, and recruitment. However, when declining production is accompanied by changes in fish size structure, it may signal exploitation pressure.

Modern fisheries management increasingly emphasizes biological evidence as the basis for decision-making. Under an Ecosystem Approach to Fisheries Management, biological indicators are used to evaluate resource status and guide precautionary management (Hutubessy & Mosse, 2015). For small pelagic fisheries, length-frequency distribution, length-weight relationship, and condition factor are practical indicators because they can be obtained from landing-site sampling and interpreted in relation to growth, physiological condition, and possible fishing pressure (Froese, 2004; Froese, 2006).

Previous studies on yellowstripe scad in Indonesia have reported biological variation among regions, including differences in dominant length, growth pattern, and condition factor. However, most studies have been conducted outside the Banda Sea sector of Morowali. Biological parameters from Tomini Bay, Sorong, Indramayu, Pekalongan, Manado Bay, or the Malacca Strait cannot be generalized to Morowali without local validation because growth and condition are influenced by habitat, food availability, season, oceanography, sex, and fishing gear selectivity.

This study addresses the lack of location-specific biological information on yellowstripe scad in Banda Sea waters around Morowali. The objectives were to analyze length-frequency distribution, length-weight relationship, growth pattern, and condition factor of yellowstripe scad landed in Bete-Bete Village from March to May 2026. The novelty of this study lies in providing empirical biological baseline data for a local small-scale fishery and translating the results into practical recommendations for sustainable fisheries management, including catch-size regulation, improved gear selectivity, and routine biological monitoring.

2. Literature Review

Banda Sea Waters and Small Pelagic Fisheries in Morowali

Banda Sea forms part of WPPNRI 714 and is characterized by dynamic oceanographic conditions shaped by monsoon-driven circulation, the Indonesian Throughflow, water-mass exchange, and local bathymetry. Such conditions influence nutrient supply, plankton productivity, and the spatial distribution of pelagic fish. Regional oceanographic studies have shown that variability in water masses and vertical structure contributes to habitat suitability for pelagic resources in the Banda Sea (Giu et al., 2020; Gordon, 2005).

Seasonal processes are especially important in eastern Indonesian waters. During monsoon periods, upwelling can bring nutrient-rich deeper water to the surface, increasing chlorophyll-a concentration and stimulating primary productivity. This process supports

zooplankton availability, which is an important food source for small pelagic fish. In Tolo Bay and adjacent waters, chlorophyll-a can increase from about 0.125–0.19 mg/m³ to approximately 0.45 mg/m³ during productive periods, while sea surface temperature can decline to around 26.5–26.59°C and salinity can reach 34.27–34.52 PSU (Takwir et al., 2021; Waas et al., 2023).

Small-scale fisheries in Morowali are closely connected to these environmental dynamics. Fishers based in Bete-Bete Village commonly operate vessels of less than 5 GT and use surface gears, including handlines and surface gillnets. The fishing grounds extend from neritic waters toward the Banda Sea and Tolo Bay, where seasonal productivity and fish aggregation patterns may affect catch composition. Because the biological response of small pelagic fish is shaped by local environmental and fishing conditions, site-specific data are required for management.

Reproductive Biology and Biological Reference Points

Yellowstripe scad is a small pelagic species belonging to the family Carangidae. It is the only species in the genus Selaroides and is widely distributed in tropical Indo-West Pacific waters (Food and Agriculture Organization, 2025; Froese & Pauly, 2026). The species has a fusiform body, a yellow lateral stripe, and a black opercular spot, which are useful external characters for identification during landing-site sampling. The external morphology of the target species is presented in Figure 1.

Figure 1. Yellowstripe scad (*Selaroides leptolepis*), the target species analyzed in this study.

Reported biological characteristics of yellowstripe scad vary across regions. The species commonly occurs at 13–17 cm in many coastal fisheries, whereas reported maturity sizes in Indonesian waters range roughly from 8.5 to 12 cm depending on location. Such variation reflects the plasticity of small pelagic fish populations and may be driven by temperature, productivity, food availability, fishing pressure, reproductive timing, and habitat quality. Therefore, local estimation of biological parameters remains essential.

Yellowstripe scad feeds mainly on zooplankton, small crustaceans, and marine larvae, and its feeding activity is often associated with pelagic schooling behavior. Its growth and body condition are expected to respond to seasonal productivity and prey availability. This makes condition factor and length-weight relationship useful tools for evaluating whether the local environment supports adequate energy acquisition

Growth Indicators and Fisheries Management

Length-frequency distribution is a basic but powerful tool for describing the size structure of a fish population. By grouping total length into classes, researchers can identify dominant size groups, possible cohorts, recruitment signals, and whether the catch is dominated by small or adult-sized individuals. Length-based approaches are widely used in tropical and data-limited fisheries because direct age information is often unavailable (Sparre & Venema, 1998).

The length-weight relationship is commonly expressed as $W = aL^b$, where W is body weight, L is total length, a is the intercept, and b is the growth coefficient. A b value not significantly different from 3 indicates isometric growth, while $b > 3$ indicates positive allometry and $b < 3$ indicates negative allometry. However, b should not be treated as a fixed species trait because it can vary with sex, season, maturity, size range, food availability, and environmental condition (Froese, 2006; Le Cren, 1951).

Condition factor describes the relative robustness or physiological well-being of fish. High values generally indicate favorable body condition, adequate food supply, and sufficient energy reserves, while low values may reflect poor habitat, limited food, stress, or post-spawning energy depletion. Because condition factor integrates length and weight responses, it can complement length-frequency and length-weight analyses in evaluating the status of a harvested population (Effendie, 2002; King, 2007).

Biological information derived from growth analysis can support sustainable management. Dominant size classes, growth pattern, and condition factor can inform minimum catch size, gear selectivity, and monitoring priorities. For small-scale fisheries, these indicators are especially valuable because they are relatively low-cost, repeatable, and interpretable by local managers when combined with catch and effort information.

3. Materials and Method

Research Design, Time, and Location

This study used a quantitative approach with a descriptive survey design. The approach was selected because the research relied on numerical biological measurements, including total length, body weight, length-frequency distribution, length-weight relationship, and condition factor. Field sampling was conducted from March to May 2026, covering three consecutive months of observation.

Fish samples were obtained from catches landed by fishers in Bete-Bete Village, Bahodopi District, Morowali Regency, Central Sulawesi. The sampling site was considered representative because fishers landing in the village operate in waters connected to the Banda Sea and Tolo Bay. Laboratory observations and data processing were conducted at the Laboratory of Aquatic Productivity and Environment, Faculty of Fisheries and Marine Sciences, Halu Oleo University, Kendari. The study location is presented in Figure 2.

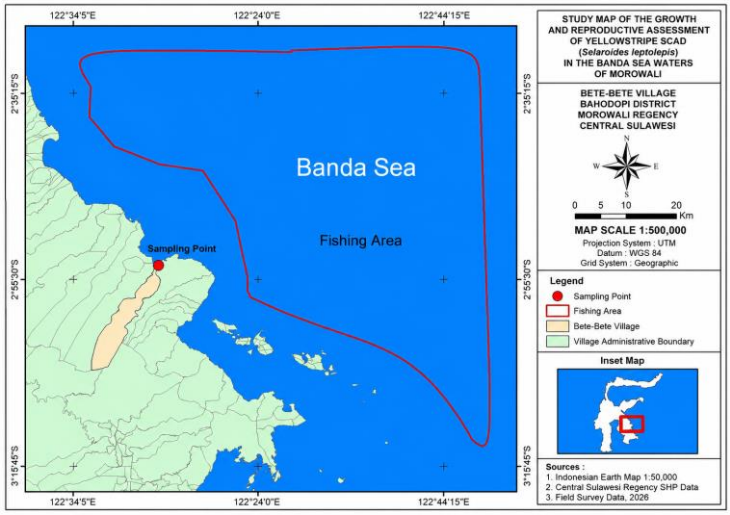

Figure 2. Study location in Bete-Bete Village, Bahodopi District, Morowali Regency, Central Sulawesi.

Sampling Procedure and Sample Size

Samples were collected from local fishers using a modified stratified random sampling approach at each landing event. This method was used to reduce size bias caused by fishing gear selectivity and to ensure that specimens represented the smallest to largest size groups landed during the sampling day. Only fresh fish with intact morphology were included. Fish with severe physical damage, broken caudal fins, decomposed tissue, or other conditions that could affect total length and body weight measurement were excluded.

The minimum sample size was calculated using a population-proportion formula for an unknown or infinite population at a 95% confidence level, producing a minimum requirement of 385 individuals. To strengthen representativeness and follow length-frequency analysis recommendations for small pelagic fish, 150 individuals were sampled each month. The total number of specimens analyzed over three months was therefore 450 fish.

Measurement of Biological Parameters

Each selected fish was identified taxonomically and measured for total length and body weight. Total length was measured from the anterior tip of the snout to the end of the extended caudal fin using a ruler with 1 mm precision. Body weight was measured using a digital scale with 0.01 g precision. The use of calibrated instruments was intended to minimize measurement error.

Data quality control was applied during field and laboratory work. Measurements were carried out consistently by the same researcher to reduce inter-observer variability. Each measurement was repeated three times, and the average value was used for final analysis. All

data were recorded immediately in a structured field logbook to maintain traceability and reduce transcription error.

Data Analysis

Length-frequency distribution was analyzed by grouping total length into classes based on Sturges' rule, $k = 1 + 3.3 \log n$, where k is the number of length classes and n is the number of fish. Class width was calculated as $c = (Lmax - Lmin) / k$, where Lmax is maximum length and Lmin is minimum length. The resulting length classes were used to calculate monthly frequencies by sex.

The length-weight relationship was analyzed using $W = aL^b$, where W is body weight in grams, L is total length in millimeters, a is the intercept, and b is the growth coefficient. The equation was log-transformed into $\ln W = \ln a + b \ln L$, and linear regression was applied with ln L as the independent variable and ln W as the dependent variable. The coefficient of determination was used to evaluate how much variation in body weight was explained by total length.

Growth pattern was determined through a t-test of the b value at a 95% confidence level. The null hypothesis was $b = 3$, indicating isometric growth, whereas the alternative hypothesis was $b \neq 3$, indicating allometric growth. Growth was interpreted as positive allometric when b was significantly greater than 3 and negative allometric when b was significantly less than 3. Condition factor was calculated using Fulton's condition factor for isometric growth and relative condition factor for allometric growth to avoid length-related bias.

4. Results and Discussion

General Characteristics of the Fishing Area

Capture fisheries in Bete-Bete Village were dominated by small-scale operations using motorized vessels of less than 5 GT. Fishers commonly used surface gears, particularly handlines and surface gillnets, to target small pelagic fish. This fishing pattern shows strong dependence on nearshore pelagic resources and highlights the need for biologically informed management measures that remain feasible for small-scale fishers.

The fishing grounds extended from neritic waters toward the Banda Sea and Tolo Bay. These waters are influenced by seasonal water-mass movement, variable bathymetry, and productivity changes. Oceanographic variability can affect plankton availability and the spatial distribution of small pelagic fish, which in turn may influence growth pattern, body condition, and catch composition.

Length-Frequency Distribution

Total length of yellowstripe scad sampled during March-May 2026 ranged from 138 to 203 mm. Most individuals were concentrated in the 171-190 mm range, with dominant classes at 178-183 mm and 184-190 mm. This pattern indicates that the catch was mainly composed of medium to adult-sized individuals. The observed length range is consistent with the biological size range of S. leptolepis, which is reported to reach a maximum total length of 22.0 cm and a common length of approximately 15.0 cm (FishBase, 2026).

In March, both female and male fish showed the highest frequency in the 178-183 mm length class. Female fish were more abundant in this class and showed a relatively wider size distribution. In April, the overall distribution remained similar, but the frequency of fish in the 171-177 mm class increased. In May, the female distribution peak shifted to 184-190 mm, whereas male fish remained dominant in the 178-183 mm class. These monthly shifts suggest that size composition varied during the sampling period and may reflect recruitment, movement, reproductive condition, or gear selectivity.

The dominance of the 178-190 mm range has important management relevance because it is close to the female Lm50 of 179.65 mm estimated in this study. Many captured individuals were therefore near or above the first maturity length. However, the presence of individuals below this threshold indicates that immature or not-yet-mature females may still enter the catch. From a precautionary perspective, a fishery should maximize the proportion of mature fish in the catch and reduce systematic harvest of juveniles (Froese, 2004).

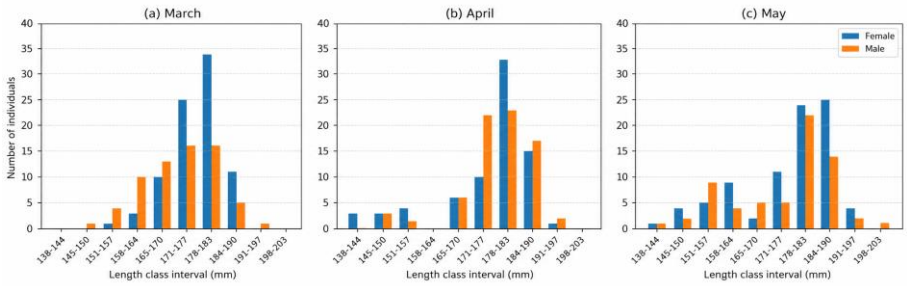

Figure 3. Length-frequency distribution of yellowstripe scad (*Selaroides leptolepis*) sampled from Banda Sea waters around Morowali during March–May 2026: (a) March, (b) April, and (c) May.

Table 1. Monthly length-frequency distribution of yellowstripe scad by sex.

Length class (mm)	March female	March male	April female	April male	May female	May male
138–144	0	0	3	1	1	1
145–150	0	1	3	3	4	2
151–157	1	4	4	1	5	9
158–164	3	10	0	0	9	4
165–170	10	13	6	6	2	5
171–177	25	16	10	22	11	5
178–183	34	16	33	23	24	22
184–190	11	5	15	17	25	14
191–197	0	1	1	2	4	2
198–203	0	0	0	0	0	1

Table 2. Comparison of dominant yellowstripe scad length among regions based on the manuscript synthesis.

Location	Dominant length	Interpretation
Banda Sea, Morowali	178-190 mm	Medium to adult-sized catch; near female Lm50
Tomini Bay	165 mm midpoint	Smaller dominant size reported in the original manuscript comparison
Sorong	185-195 mm	Comparable to the upper dominant range observed in Morowali
Makassar Strait	110 mm average	Substantially smaller size reported in the original manuscript comparison

Length-Frequency Distribution

The length-weight relationship showed a positive association between total length and body weight in both female and male fish. The coefficient of determination was relatively high across monthly sex-based groups, ranging from 79.88% to 94.79%. This indicates that total length explained most of the variation in body weight during the study period. The fitted length-weight relationships by sex and month are presented in Figure 4.

In March, female fish showed isometric growth with the equation $W = 2 \times 10^{-5}L^{2.9193}$ and $R^2 = 79.88\%$. Male fish in the same month showed negative allometric growth with $W = 0.0001L^{2.5408}$ and $R^2 = 83.81\%$. This indicates that March males gained length faster than weight, producing a relatively more slender body form.

In April, both female and male fish showed isometric growth. Female fish had $W = 7 \times 10^{-6}L^{3.1015}$ with $R^2 = 94.79\%$, while males had $W = 3 \times 10^{-5}L^{2.8689}$ with $R^2 = 91.06\%$. In May, both sexes also showed isometric growth, with female and male equations of $W = 3 \times 10^{-5}L^{2.7961}$ and $W = 3 \times 10^{-5}L^{2.8096}$, respectively.

Overall, the population showed predominantly isometric growth, meaning that length and weight increased proportionally. The only exception was male fish in March, which showed negative allometry. This temporal deviation may reflect sex-specific physiological condition, reproductive energy allocation, or short-term environmental variability.

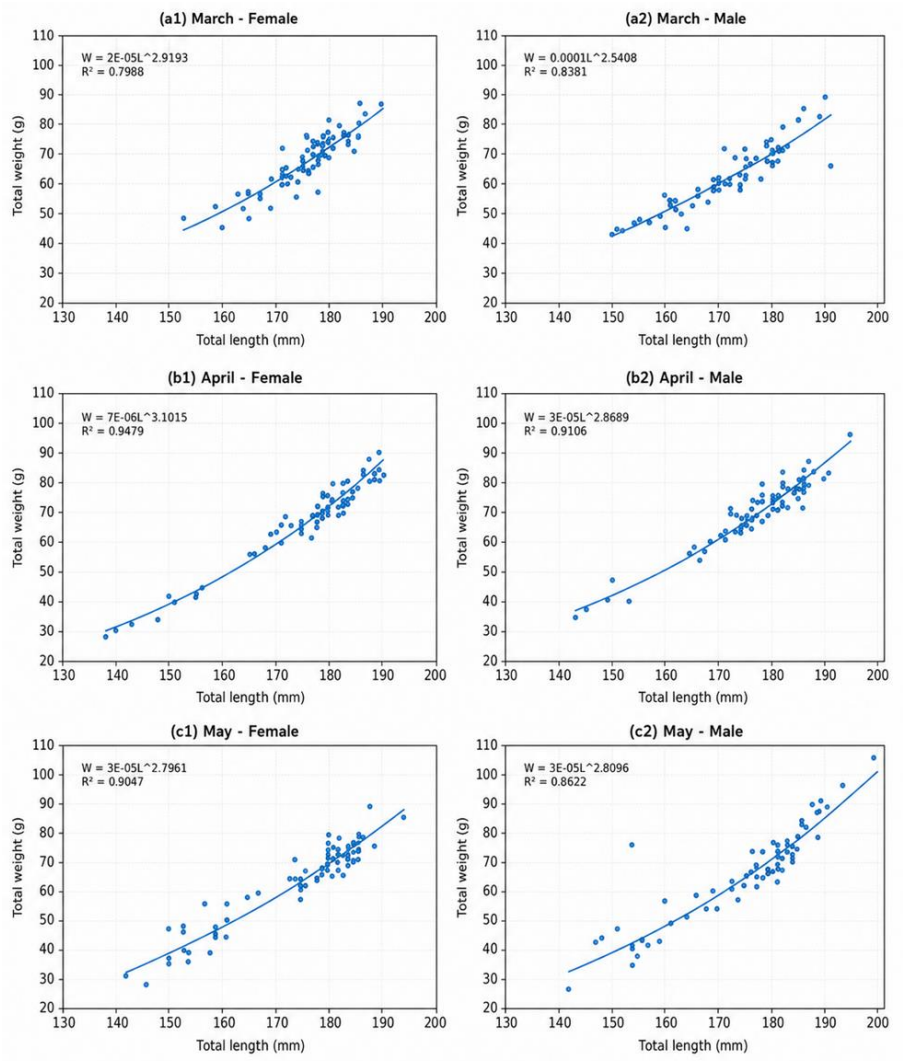

Figure 4. Length-weight relationships of female and male yellowstripe scad in March, April, and May.

Table 3. Length-weight relationship and final growth pattern of yellowstripe scad.

Month	Sex	n	Length-weight equation	R^2 (%)	SE b	t-count	t-table	Final interpretation
March	Female	84	$W = 2E{-}05L^{2.9193}$	79.88	0.16024	−0.50384	1.98932	Isometric
March	Male	66	$W = 0.0001L^{2.5408}$	83.81	0.1318	−3.4838	1.9977	Negative allometric
April	Female	75	$W = 7E{-}06L^{3.1015}$	94.79	0.0714	1.4229	1.9930	Isometric
April	Male	66	$W = 3E{-}05L^{2.8689}$	91.06	0.0929	−1.4108	1.9977	Isometric
May	Female	85	$W = 3E{-}05L^{2.7961}$	90.47	0.1043	−1.5308	1.9890	Isometric
May	Male	65	$W = 3E{-}05L^{2.8096}$	86.22	0.1515	−1.5559	1.9983	Isometric

Condition Factor

Condition factor values were generally above 1.0, indicating that captured yellowstripe scad were in good physiological condition. Across sex and month, values generally ranged from approximately 1.0 to 1.4, although class-level values varied by length group. Fish with condition factor above 1.0 are generally considered to have sufficient body

mass relative to length, suggesting adequate food availability and favorable habitat conditions. The monthly condition-factor patterns are shown in Figure 5.

In March, female condition factor ranged approximately from 1.23 to 1.39, whereas male condition factor ranged from approximately 0.97 to 1.37. The lowest male value occurred in the largest length class, suggesting that larger males may have had lower relative body mass during that month. In April, both sexes showed more stable condition, with females ranging from approximately 1.15 to 1.28 and males from approximately 1.14 to 1.31.

In May, condition factor fluctuated more strongly than in previous months. Female values ranged approximately from 1.19 to 1.33, while male values ranged from approximately 1.02 to 1.45. Despite this variation, most values remained above 1.0, indicating that the population maintained favorable physiological status during the observation period.

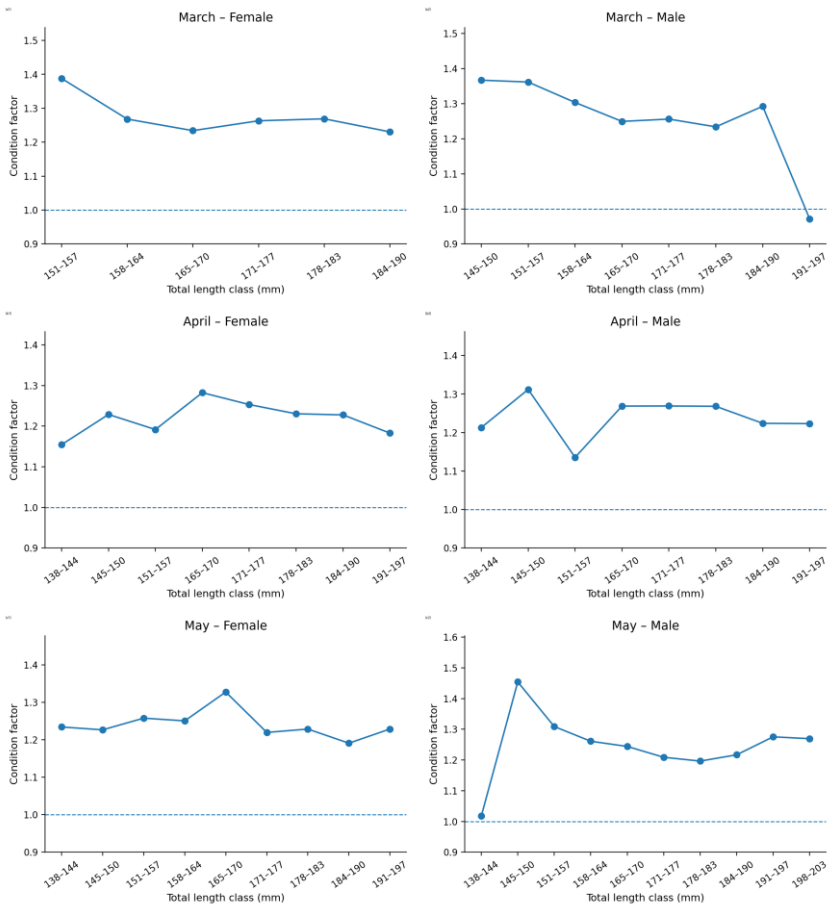

Figure 5. Condition factor of yellowstripe scad (*Selaroides leptolepis*) by sex and sampling month: female (1) and male (2) in (a) March, (b) April, and (c) May.

Table 3. First maturity length (Lm50) and first capture length (Lc50) of yellowstripe scad.

Month	Sex	Approximate condition factor range	Interpretation
March	Female	1.23–1.39	Good condition; relatively stable across medium-large sizes
March	Male	0.97–1.37	Mostly good condition; lowest value in largest size class
April	Female	1.15–1.28	Stable and good condition
April	Male	1.14–1.31	Stable and good condition
May	Female	1.19–1.33	Good condition with moderate fluctuation
May	Male	1.02–1.45	Good condition with higher fluctuation

Female first maturity length was estimated at 179.65 mm, while male first maturity length was 167.33 mm. Female first capture length was 171.95 mm, which was lower than female Lm50. This means that part of the female catch was composed of fish that had not reached first gonad maturity. In contrast, male Lc50 was 169.48 mm, slightly higher than male Lm50, indicating that most males had the opportunity to mature before capture.

The condition Lc50 < Lm50 in females is a critical warning signal. Females directly determine egg production, and fishing before first maturity can reduce the number of individuals contributing to spawning. Previous fisheries theory emphasizes that protecting size and age structure, particularly reproductive females, can improve stock resilience (Berkeley et al., 2004; Lowerre-Barbieri et al., 2017). Therefore, the female maturity-capture mismatch observed in Morowali should be addressed through management measures that increase selectivity and allow females to reproduce at least once before capture

Discussion

The The results show that yellowstripe scad landed in Bete-Bete Village had a total length range of 138–203 mm and were dominated by the 171–190 mm size range. This dominance indicates that the catch was primarily composed of medium-to-large individuals rather than very small juveniles. The concentration of fish around 178–190 mm is biologically meaningful because this range is close to the first maturity length of 179.65 mm reported in the manuscript data. Therefore, many fish in the catch were likely near or above reproductive size.

Length distribution in Morowali differed from comparative values reported for other Indonesian waters. The dominant length in Morowali was higher than the midpoint reported for Tomini Bay and the average reported for the Makassar Strait, but it overlapped with the upper range reported for Sorong. Such differences are expected because growth and captured size are affected by habitat productivity, recruitment timing, season, exploitation level, and gear selectivity. Therefore, the Morowali population should be assessed using local data rather than generalized values from other regions.

The predominantly isometric growth pattern suggests that yellowstripe scad in the study area maintained proportional increases in length and weight during March–May 2026. This condition generally reflects adequate energy intake and physiological balance. Isometric growth has also been reported for yellowstripe scad in the Visayan Sea, whereas other Indonesian studies have found positive or negative allometry. These differences reinforce the interpretation that the b coefficient is dynamic and influenced by biological and environmental conditions rather than being a rigid taxonomic attribute (Froese, 2006; Le Cren, 1951).

The negative allometric growth observed in March males should be interpreted cautiously but is still biologically informative. Negative allometry means that body length increased faster than body weight, producing a relatively slimmer body form. This condition may be associated with post-spawning energy depletion, reduced food intake, higher swimming activity, or sex-specific energy allocation. Because this pattern occurred only in one sex-month group, it likely reflects temporal or physiological variation rather than a general population condition.

Condition factor results support the conclusion that the population was in favorable physiological condition. Values were mostly above 1.0 and generally ranged from approximately 1.0 to 1.4. This indicates that fish had sufficient body mass relative to length and likely benefited from adequate food availability. In the context of Banda Sea and Tolo Bay waters, seasonal productivity and plankton availability may provide a strong energetic basis for small pelagic fish growth. Environmental conditions such as temperature, salinity, and productivity can strongly influence fish physiology and growth responses (Canosa & Bertucci, 2023; King, 2007).

Variation in condition factor between sex, month, and size class may reflect differences in reproductive condition and energy allocation. Female fish often show changes in condition related to gonad development, because vitellogenesis and egg production increase body mass. Male fish may show less pronounced increases or may lose condition if energy is allocated to spawning activity and movement. Therefore, condition factor should be interpreted together with length structure and growth pattern rather than as a standalone indicator.

From a management perspective, the results suggest that the Morowali yellowstripe scad population remained biologically healthy during the sampling period. However, healthy condition at one observation period does not guarantee long-term sustainability. Small pelagic fish can respond quickly to increased fishing pressure, environmental fluctuations, and

recruitment variability. The capture of some individuals below the first maturity size indicates that precautionary measures are still needed to prevent gradual erosion of recruitment potential.

The most practical management recommendation is to use a minimum catch size close to or above the first maturity reference point. Because the maturity value cited in the manuscript is 179.65 mm, a minimum legal size of approximately 180 mm total length would provide a clear operational threshold. Gear selectivity should also be improved so that fish below this size have a higher probability of escaping capture. Such regulation should be developed through consultation with local fishers to ensure that conservation objectives are balanced with livelihood feasibility.

Routine biological monitoring is also essential. Landing-site monitoring should record total length, body weight, sex, maturity, and fishing gear information. If future monitoring detects a decline in dominant length, a lower condition factor, or an increased proportion of fish below 180 mm, management should be strengthened. Length-based monitoring provides a feasible approach for data-limited small-scale fisheries and can support adaptive management under the Ecosystem Approach to Fisheries Management.

5. Conclusion

Yellowstripe scad (Selaroides leptolepis) landed in Bete-Bete Village, Morowali, had a total length range of 138–203 mm and were dominated by the 171–190 mm size range, indicating that catches mainly consisted of medium-to-large individuals. The length-weight relationship showed strong positive associations, with R^2 values ranging from 79.88% to 94.79%. Growth was generally isometric in females and males across the observation period, except for males in March, which showed negative allometric growth. Condition factor values were mostly above 1.0 and generally ranged from approximately 1.0 to 1.4, suggesting that the sampled fish were in good physiological condition and supported by productive habitat conditions in Banda Sea waters around Morowali. These findings indicate that the local population remained biologically healthy during March–May 2026. Nevertheless, sustainable use requires precautionary management because some individuals below reproductive size were still captured. A minimum catch size of approximately 180 mm total length, improved gear selectivity, protection of immature fish, and routine landing-site monitoring are recommended to maintain recruitment and long-term fishery productivity. Future research should cover a full annual cycle to confirm seasonal variability, reproductive timing, and the influence of oceanographic dynamics on yellowstripe scad growth and condition.

.

Author Contributions: Conceptualization: A.M. and I.A.Y.; Methodology: A.M. and I.A.Y.; Software: A.M.; Validation: I.A.Y., T.D., A.T., and D.S.A.; Formal analysis: A.M.; Investigation: A.M.; Resources: A.M.; Data curation: A.M.; Writing—original draft preparation: A.M.; Writing—review and editing: I.A.Y., T.D., and D.S.A.; Visualization: A.M.; Supervision: I.A.Y. and T.D.; Project administration: A.T. and D.S.A.; Funding acquisition: A.M. All authors have read and agreed to the published version of the manuscript.
Funding: This research received no external funding.
Data Availability Statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request.
Acknowledgments: The authors thank the fishers of Bete-Bete Village, Bahodopi District, Morowali Regency, for their assistance during sample collection, and the Laboratory of Aquatic Productivity and Environment, Faculty of Fisheries and Marine Sciences, Halu Oleo University, Kendari, for supporting biological measurements
Conflicts of Interest: The authors declare no conflict of interest.

References

Abudi, M. K., & Nane, L. (2021). Analisis hubungan panjang–berat, tingkat kematangan gonad, indeks kematangan gonad, serta fekunditas ikan selar kuning (Selaroides leptolepis Cuvier, 1833). Fisheries and Society, 1(1), 5–10.

Badan Pusat Statistik Provinsi Sulawesi Tengah. (2022). Produksi dan nilai produksi perikanan tangkap menurut kabupaten/kota dan jenis penangkapan di Provinsi Sulawesi Tengah tahun 2022. https://sulteng.bps.go.id/

Béné, C. (2006). Small-scale fisheries: Assessing their contribution to rural livelihoods in developing countries. FAO Fisheries Circular. https://www.fao.org/4/j7551e/j7551e.pdf

Berkeley, S. A., Chapman, C., & Sogard, S. M. (2004). Maternal age as a determinant of larval growth and survival in a marine fish, Sebastes melanops. Ecology, 85(5), 1258–1264. https://doi.org/10.1890/03-0706

Canosa, L. F., & Bertucci, J. I. (2023). The effect of environmental stressors on growth in fish and its endocrine control. Frontiers in Endocrinology, 14, 1109461. https://doi.org/10.3389/fendo.2023.1109461

Clarito, Q. Y. (2021). Length–weight relationship and relative condition factor of yellowstripe scad, Selaroides leptolepis (Cuvier, 1833), in the Visayan Sea, Philippines. Aceh Journal of Animal Science, 6(3), 74–78. https://doi.org/10.13170/ajas.6.3.20220

Effendie, M. I. (2002). Biologi perikanan. Yayasan Pustaka Nusatama.

Food and Agriculture Organization. (2025). Selaroides leptolepis Cuvier, 1833. Fisheries and Aquaculture. https://www.fao.org/fishery/en/aqspecies/3126/en

Froese, R. (2004). Keep it simple: Three indicators to deal with overfishing. Fish and Fisheries, 5(1), 86–91. https://doi.org/10.1111/j.1467-2979.2004.00144.x

Froese, R. (2006). Cube law, condition factor and weight–length relationships: History, meta-analysis and recommendations. Journal of Applied Ichthyology, 22(4), 241–253. https://doi.org/10.1111/j.1439-0426.2006.00805.x

Froese, R., & Pauly, D. (Eds.). (2026). FishBase: Selaroides leptolepis, yellowstripe scad. https://www.fishbase.se/summary/Selaroides-leptolepis.html

Froese, R., Stern-Pirlot, A., Winker, H., & Gascuel, D. (2008). Size matters: How single-species management can contribute to ecosystem-based fisheries management. Fisheries Research, 92(2–3), 231–241. https://doi.org/10.1016/j.fishres.2008.01.005

Funge-Smith, S., & Bennett, A. (2019). A fresh look at inland fisheries and their role in food security and livelihoods. Fish and Fisheries, 20(6), 1175–1195. https://doi.org/10.1111/faf.12403

Giu, L. O. M. G., Atmadipoera, A. S., Naulita, Y., & Nugroho, D. (2020). Struktur vertikal dan variabilitas Arlindo yang masuk ke tepi barat Laut Banda. Jurnal Ilmu dan Teknologi Kelautan Tropis, 12(2), 457–472. https://doi.org/10.29244/jitkt.v12i2.29142

Gordon, A. L. (2005). Oceanography of the Indonesian seas and their throughflow. Oceanography, 18(4), 14–27. https://doi.org/10.5670/oceanog.2005.01

Harahap, I. C. R., & Sinaga, M. P. (2025). Hubungan panjang berat dan faktor kondisi ikan selar kuning (Selaroides leptolepis) yang tertangkap di Pelabuhan Perikanan Samudera Belawan Provinsi Sumatera Utara. SEMAH Jurnal Pengelolaan Sumberdaya Perairan, 9(2), 130–130. https://doi.org/10.36355/semahjpsp.v9i2.1897

Haruna, Mallawa, A., Musbir, & Zainuddin, M. (2018). Population dynamic indicator of the yellowfin tuna Thunnus albacares and its stock condition. AACL Bioflux, 11(4), 1323–1333. http://www.bioflux.com.ro/aacl

Hiariey, J., & Baskoro, M. S. (2017). Kapasitas perikanan pelagis kecil di Wilayah Pengelolaan Perikanan 714 Laut Banda Maluku. Jurnal Kebijakan Perikanan Indonesia, 2(1), 43–56. https://doi.org/10.15578/jkpi.2.1.2010.43-56

Hutubessy, B. G., & Mosse, J. W. (2015). Ecosystem approach to fisheries management in Indonesia: Review on indicators and reference values. Procedia Environmental Sciences, 23, 148–156. https://doi.org/10.1016/j.proenv.2015.01.023

Kementerian Kelautan dan Perikanan Republik Indonesia. (2024). Produksi perikanan tangkap: Selar. https://portaldata.kkp.go.id/datainsight/produksi-ikan-tangkap/73/SELAR

King, M. (2007). Fisheries biology, assessment and management (2nd ed.). Blackwell Publishing. https://doi.org/10.1002/9781118688038

Le Cren, E. D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (Perca fluviatilis). Journal of Animal Ecology, 20(2), 201–219. https://doi.org/10.2307/1540

Manik, H. M., Sujatmiko, T. N., Ma'mun, A., & Priatna, A. (2018). Penerapan teknologi hidroakustik untuk pengukuran sebaran spasial dan temporal ikan pelagis kecil di Laut Banda. Marine Fisheries: Journal of Marine Fisheries Technology and Management, 9(1), 41–53. https://doi.org/10.29244/jmf.9.1.39-52

Nadhifa, R. F., Solichin, A., & Rahman, A. (2023). Growth and utilization rate of yellowstripe scad (Selaroides leptolepis Cuvier, 1833) landed at Pekalongan Archipelago Fishing Port. Acta Aquatica: Aquatic Sciences Journal, 10(2), 146–152. https://doi.org/10.29103/aa.v10i2.10416

Pasisingi, N., Pramesthy, T. D., & Musyali, A. (2021). Length–weight relationships and sex ratio of Selaroides leptolepis Cuvier, 1833 in Tomini Bay, Indonesia. IOP Conference Series: Earth and Environmental Science, 744(1), 012052. https://doi.org/10.1088/1755-1315/744/1/012052

Pikitch, E. K., Rountos, K. J., Essington, T. E., Santora, C., Pauly, D., Watson, R., Sumaila, U. R., Boersma, P. D., Boyd, I. L., Conover, D. O., Cury, P., Heppell, S. S., Houde, E. D., Mangel, M., Sainsbury, K., Steneck, R. S., Geers, T. M., Gownaris, N., & Munch, S. B. (2014). The global contribution of forage fish to marine fisheries and ecosystems. Fish and Fisheries, 15(1), 43–64. https://doi.org/10.1111/faf.12004

Sinaga, F., Tilaar, F. F., & Bataragoa, N. E. (2018). Karakteristik reproduksi ikan selar kuning Selaroides leptolepis (Cuvier, 1833) di perairan Teluk Manado. Jurnal Ilmiah Platax, 6(2), 46–57. http://ejournal.unsrat.ac.id/index.php/platax

Smith, A. D. M., Brown, C. J., Bulman, C. M., Fulton, E. A., Johnson, P., Kaplan, I. C., Lozano-Montes, H., Mackinson, S., Marzloff, M., Shannon, L. J., Shin, Y., & Tam, J. (2011). Impacts of fishing low-trophic level species on marine ecosystems. Science, 333(6046), 1147–1150. https://doi.org/10.1126/science.1209395

Sparre, P., & Venema, S. C. (1998). Introduction to tropical fish stock assessment. Part 1: Manual. FAO Fisheries Technical Paper No. 306/1, Rev. 2. Food and Agriculture Organization. https://www.fao.org/4/w5449e/w5449e00.htm

Sturges, H. A. (1926). The choice of a class interval. Journal of the American Statistical Association, 21(153), 65–66. https://doi.org/10.1080/01621459.1926.10502161

Suman, A., Satria, F., Nugraha, B., Priatna, A., Amri, K., & Mahiswara. (2018). Status stok sumber daya ikan tahun 2016 di wilayah pengelolaan perikanan negara Republik Indonesia (WPP NRI) dan alternatif pengelolaannya. Jurnal Kebijakan Perikanan Indonesia, 10(2), 107–128. http://ejournal-balitbang.kkp.go.id/index.php/jkpi

Takwir, A., Rondonuwu, A. B., Wahidin, N., Rahman, A. A., Giu, L. O. M. G., & Erawan, M. T. F. (2021). Analisis kejadian upwelling dan daerah potensial penangkapan ikan tuna di perairan Teluk Tolo. Jurnal Enggano, 6(2), 238–252. https://doi.org/10.31186/jenggano.6.2.238-252

Tarigan, A., Bakti, D., & Desrita. (2017). Tangkapan dan tingkat kematangan gonad ikan selar kuning (Selaroides leptolepis) di perairan Selat Malaka. Acta Aquatica: Aquatic Sciences Journal, 4(2), 44–52. https://doi.org/10.29103/aa.v4i2.318

Waas, H. J. D., Tubalawony, S., & Hukubun, R. D. (2023). Kedalaman klorofil maksimum selama musim peralihan II dan implikasinya untuk perikanan tuna di Laut Banda. Jurnal Laut Pulau, 2, 1–14. https://doi.org/10.30598/jlpvol2i

Wijaya, A., Priyono, B., & Mahdalena, N. C. (2018). Karakteristik spasial temporal kondisi oseanografi Laut Banda dan hubungannya dengan potensi sumberdaya perikanan. Journal of Fisheries and Marine Research, 2(2), 75–85. https://doi.org/10.21776/ub.jfmr.2018.002.02.4

Wootton, R. J., & Smith, C. (2015). Reproductive biology of teleost fishes. Wiley-Blackwell. https://doi.org/10.1002/9781118891360

Yanti, D. I. W., Masengi, M., & Palemba, Y. P. (2023). Analisis hubungan panjang–berat pada ikan selar kuning Selaroides leptolepis di pangkalan pendaratan ikan Kota Sorong. Nekton, 3(2), 122–132. https://doi.org/10.47767/nekton.v3i2.402