*Fisheries Journal,* 15 (5), 2481-2492 (2025)
http://doi.org/10.29303/jp.v15i5.1792

# LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF GREENBACK GAUVINA (*BUNAKA GYRINOIDES* BLEEKER, 1853) IN THE CIKASO RIVER, SUKABUMI, INDONESIA

Hubungan Panjang-Berat dan Faktor Kondisi Ikan Bobosoh (*Bunaka gyrinoides* Bleeker, 1853) di Sungai Cikaso, Sukabumi, Indonesia

**Faqih Baihaqi[1*], Shafira Bilqis Annida[2], Ufaira Suci Ramadhani[3], Nazwa Fairuz Nuraeni[3], Alya Syafitri[3]**

[1]Department of Fisheries, Universitas Padjadjaran, [2]Study Program of Marine Tourism, Universitas Padjadjaran, [3]Study Program of Fisheries, Universitas Padjadjaran,

*Bandung Sumedang Main Street KM 21, Jatinangor, West Java 45365*

[*]Corresponding author: faqih.baihaqi@unpad.ac.id

(Received August 19th 2025; Accepted October 25th 2025)

## ABSTRACT

The Cikaso River is a lotic aquatic ecosystem in the southeastern Sukabumi Regency, West Java. As one of the major rivers, Cikaso boasts a relatively high fish biodiversity. One species of fish found in the Cikaso River is the Greenback gauvina (*Bunaka gyrinoides*). Greenback gauvina, or what the local community calls *Bobosoh*, is widely used for consumption in adult and the juvenile stadiums. Until now, research on the *bobosoh* fish in the Cikaso River has been limited to discussions of abundance, migration patterns, and its existence in relation to aquatic environment parameters. The study of fish biology parameters, especially regarding the growth of *bobosoh* fish in the Cikaso River, is not widely known. This study uncovered growth parameters related to the length-weight relationship, growth pattern, and condition factors of the *bobosoh* fish in the Cikaso River. Fish sampling was executed for one full year from January to December 2021. A total of 539 *bobosoh* fish with a total length range of 86-236 mm were collected during the study with the help of traps fishing gear. Data analysis of the total length and weight of *bobosoh* fish reveals a relationship pattern that follows the function $W = 0.0014 L^{2.0895}$, with a correlation coefficient of 0.96. Based on this function, it is known that *bobosoh* fish in the Cikaso River exhibit a negative allometric growth pattern ($B < 3$), i.e., the length tends to be more dominant than its weight growth. The value of *bobosoh* fish conditions during the study ranged from 0.88 to 1.37. The highest condition factor value in the transition season from the rainy season to the dry season in April is low at the end of the dry season in August.

**Keywords**: Condition factors, fish biology, greenback gauvina, growth patterns, length-weight relationships.

**ABSTRAK**

Sungai Cikaso merupakan ekosistem perairan lotik di bagian tenggara Kabupaten Sukabumi, Jawa Barat. Sebagai salah satu sungai utama, Cikaso memiliki keanekaragaman hayati ikan yang relatif tinggi. Salah satu spesies ikan yang ditemukan di Sungai Cikaso adalah ikan bobosoh (*Bunaka gyrinoides*). Ikan bobosoh banyak dimanfaatkan untuk konsumsi pada stadium dewasa dan yuwana. Hingga saat ini, penelitian tentang ikan bobosoh di Sungai Cikaso terbatas pada pembahasan tentang kelimpahan, pola migrasi, dan keberadaannya dalam kaitannya dengan parameter lingkungan perairan. Kajian tentang parameter biologi ikan, khususnya pertumbuhan ikan bobosoh di Sungai Cikaso, belum banyak diketahui. Penelitian ini mengungkap parameter pertumbuhan yang berkaitan dengan hubungan panjang-berat, pola pertumbuhan, dan faktor kondisi ikan bobosoh di Sungai Cikaso. Pengambilan sampel ikan dilaksanakan selama satu tahun penuh dari Januari hingga Desember 2021. Sebanyak 539 ekor ikan bobosoh dengan rentang panjang total 86-236 mm berhasil dikumpulkan selama penelitian dengan bantuan alat tangkap bubu. Analisis data panjang total dan berat ikan bobosoh menunjukkan pola hubungan yang mengikuti fungsi $W = 0{,}0014\ L^{2{,}0895}$, dengan koefisien korelasi sebesar 0,96. Berdasarkan fungsi tersebut, diketahui bahwa ikan bobosoh di Sungai Cikaso menunjukkan pola pertumbuhan alometrik negatif ($B < 3$), yaitu pertumbuhan panjang cenderung lebih dominan daripada pertumbuhan beratnya. Nilai kondisi ikan bobosoh selama penelitian berkisar antara 0,88 sampai dengan 1,37. Nilai faktor kondisi tertinggi pada musim peralihan dari musim hujan ke musim kemarau di bulan April rendah pada akhir musim kemarau di bulan Agustus.

**Kata kunci**: Biologi ikan, faktor kondisi, hubungan panjang-berat, ikan bobosoh, pola pertumbuhan.

## INTRODUCTION

Rivers are one of the most important freshwater ecosystems, playing a crucial role in supporting biodiversity and maintaining environmental balance. Each river has characteristics that may differ from one another (Dudgeon *et al.,* 2006; Gauvin *et al.,* 2023). Cikaso is one of the large rivers in Sukabumi Regency, West Java, with unique characteristics. This river stretches approximately 60 km from the upstream area to the south coast of Java, specifically to the east of the outer region of Palabuhanratu Bay (Baihaqi *et al.,* 2025). The Cikaso River flows through tropical forests and relatively natural areas, supporting a diverse biodiversity that includes various fish species (Annida *et al.,* 2021a; Annida *et al.,* 2022; Baihaqi & Annida, 2024). This river has a rocky contour and a reasonably fast flow at several points, providing unique physical conditions for the water and influencing the distribution and adaptation of freshwater biota that live in it (Baihaqi & Annida, 2025).

One important aspect in the study of aquatic ecology is understanding fish populations as an indicator of ecosystem health (Adinalda & Sanjayasari, 2022; Baihaqi *et al.,* 2025; Niawati & Putriani, 2024). Greenback gauvina fish (*Bunaka gyrinoides* Bleeker, 1853) is one of the native fish species found in the waters of the Cikaso River, Sukabumi, West Java (Annida *et al.,* 2021a; 2022; Baihaqi, 2022). The existence of this species has ecological value and economic potential, especially for the surrounding community that depends on traditional capture fisheries for their livelihoods (Annida *et al.,* 2022).

Two biological parameters commonly used in fish population studies are the length-weight relationship and the condition factor (Baihaqi *et al.,* 2025). The length-weight relationship provides information on fish growth patterns, whether isometric (proportional growth) or allometric (disproportional growth) (Annida *et al.,* 2021b; Froese, 2006). Meanwhile, the condition factor is an index value used to assess the welfare or abundance of energy in individual fish based on their body length and weight. High condition factor values generally indicate good body condition and an environment that supports growth (Azrita *et al.,* 2024; Oyebola *et al.,* 2022).

Studies on the length-weight relationship and important condition factors are conducted as a basis for the conservation and management of fish resources, especially in river areas that face ecological pressure due to human activities (Dinh *et al.,* 2022; Nurfadillah *et al.,* 2021). Until now, scientific information on the biological aspects of Greenback gauvina fish in the Cikaso River is still minimal. Therefore, this study aims to analyze the length-weight relationship and condition factors of Greenback gauvina fish (*Bunaka gyrinoides*) caught in the Cikaso River, Sukabumi. The results of this study can contribute to providing an initial picture of population conditions and support efforts to conserve and manage sustainable Greenback gauvina fish resources.

## MATERIALS AND METHODS

### Research Location

Greenback gauvina fish samples were collected routinely every month for a full year, from January to December 2021. Samples were taken from the Cikaso River, Sukabumi, West Java, precisely at a location approximately 11 kilometers from the river mouth, at coordinates 7°20’59” S and 106°37’15” E. This location is a fishing area commonly used by local people around the Cikaso River (Baihaqi *et al.,* 2025). Figure 1 presents a map of the Greenback gauvina fish sampling location.

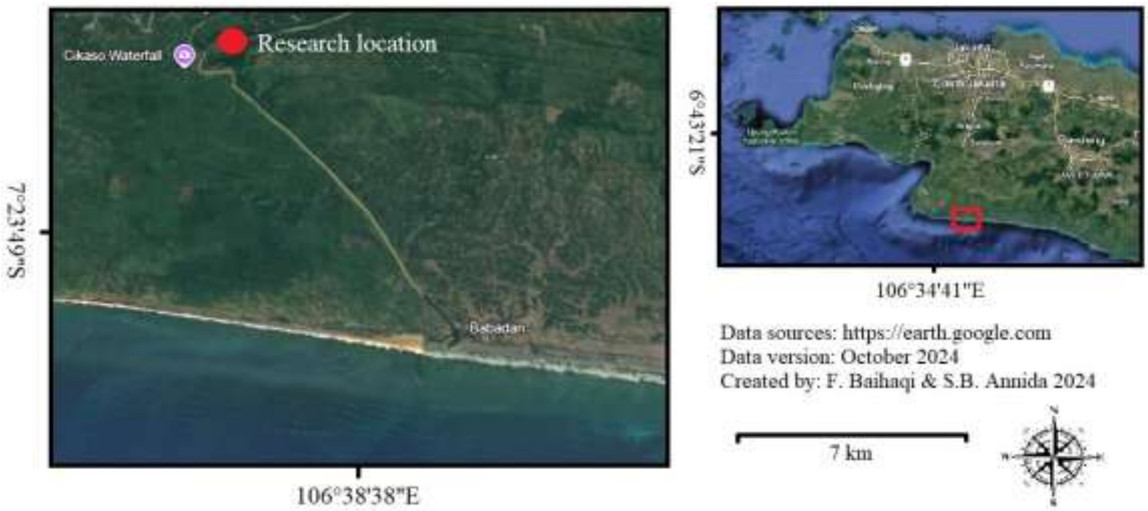


Figure 1. Map of research location

### Tools and Materials

Greenback gauvina fishing is conducted using traditional fishing gear, consisting of traps with a rattan wood frame and delicate netting covering. The traps have a length ranging from 50 to 70 cm. This tool has two levels of openings: the first opening is circular, with a diameter of 11 cm, while the second opening is a narrower triangle with an area of approximately 0.75 $cm^2$. The second opening is made of loosely woven rope and can expand up to 20–30 times its original size. This design allows the traps to catch relatively large fish that enter and are eventually trapped inside (Annida *et al.,* 2021a; Baihaqi & Annida, 2024).

In its use, the trap is typically placed between the gaps in rocks along the river flow and disguised with straw and dry leaves. The direction of the trap mouth is positioned opposite to the direction of the river water flow (Annida *et al.,* 2021a; Baihaqi & Annida, 2024). An illustration of the fishing gear's structure and its operation is shown in Figure 2.

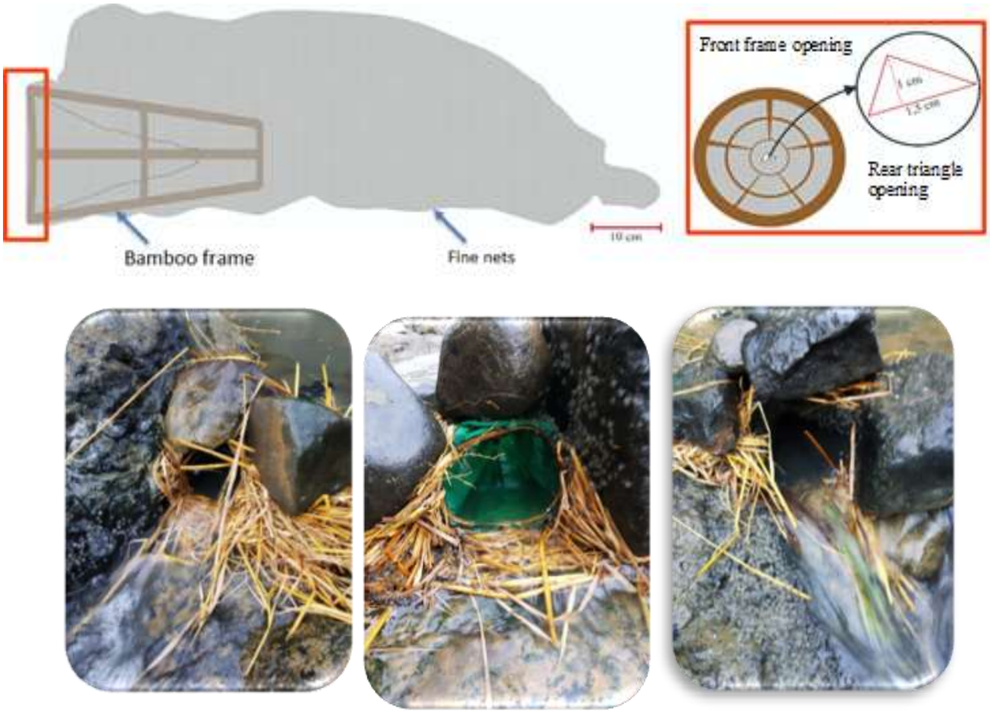


Figure 2. Construction and technical operation of traps

Each Greenback gauvina fish that was successfully caught was first preserved by soaking it in a 10% formalin solution for 3 to 4 hours. After the soaking process, the fish were rinsed with running water and then stored again in an 80% ethanol solution for long-term preservation. This technique has proven effective in extending the shelf life of samples while maintaining the quality of body color or melanophore patterns in fish (Amaliah *et al.,* 2023; Simanjuntak *et al.,* 2021).

**Data Analysis**

Each fish was then measured morphometrically to obtain total length and body weight data. Total length measurements were carried out using a ruler with an accuracy of up to 1 mm. The total length data of Greenback gauvina fish that had been collected were then analyzed to determine the frequency distribution pattern of length. The distribution of fish length is presented in the form of a bar chart, with class intervals calculated using the formula (equation 1), and the number of classes based on equation (2) (Walpole, 1995). The symbol 'K' is used to indicate the number of classes, 'n' for the number of samples, 'C' as the class interval, and 'W' indicates the range of length distribution, namely the difference between the maximum and minimum lengths.

$$K = 1 + 3{,}32\ Log\ (n) \qquad (1)$$

$$C = \frac{W}{K} \qquad (2)$$

Fish weighing was finished using a digital scale with an accuracy of up to 0.01 grams. The total length and weight data obtained were then used as the primary data to analyze the relationship between the length and weight of Greenback gauvina fish. This length-weight relationship analysis is based on the relationship formula adapted from Effendi (2002).

$$W = a\ L^{b} \qquad (3)$$

In this case, W represents the weight of the fish (in grams) and L represents the length of the fish (in millimeters). The relationship equation is then transformed into a linear form through a logarithmic transformation. This linear form is then used in the regression analysis to estimate the intercept value (a), the slope of the line or regression coefficient (b), and the coefficient of determination ($R^2$) which describes the strength of the relationship between the two variables.

$$Log\ W = Log\ a + b\ Log\ L \quad (4)$$

The slope of the curve (slope) of the length-weight relationship, denoted by the b value, describes the growth pattern of the fish. If the b value is equal to 3, then the fish growth is isometric, meaning that the increase in body length is proportional to the increase in weight. Conversely, if b is not equal to 3, then the growth is allometric, where the increase in length and weight does not occur proportionally. A b value of less than 3 indicates that the fish is experiencing faster growth in length compared to weight gain (negative allometry). Meanwhile, if b is more than 3, then weight growth is more dominant than length growth (positive allometry). To determine whether the b value is statistically different from 3, a t-test is performed using the formula adapted from Omar *et al.,* (2020).

$$t_{value} = \left[\frac{3-b}{Sb}\right] \quad (5)$$

Where Sb is the standard error for the b value, the results of the t-value calculation will be compared with the hypothetical t-table, where if the t-value> the t-table, it indicates the b value is not equal to 3 (allometric growth pattern). If otherwise, where t-value < t-table means the b value is not significantly different from 3 (isometric growth pattern).

Condition factor values are calculated monthly during the sampling period to monitor changes that occur throughout the year. Condition factor values are obtained using the ponderal index formula. For fish exhibiting isometric growth patterns, the calculation of the total length condition factor (KTL) value is based on Formula 6. Meanwhile, if the fish show allometric growth, then the condition factor value (Kn) is calculated using the equation listed in Formula 7 (Effendi, 2002).

$$K_{TL} = \left[\frac{10^5 W}{10^3}\right] \quad (6)$$

$$K_n = \left[\frac{W}{aL^b}\right] \quad (7)$$

## RESEARCH RESULT

A total of 539 individuals of Greenback gauvina fish (*Bunaka gyrinoides*) were successfully collected during a full year of research in 2021. The total length of Greenback gauvina fish ranged from 86 to 251 mm. The frequency distribution of the total length of Greenback gauvina fish formed a unimodal curve, with the highest mode in the size range of 162-176 mm (Figure 3).

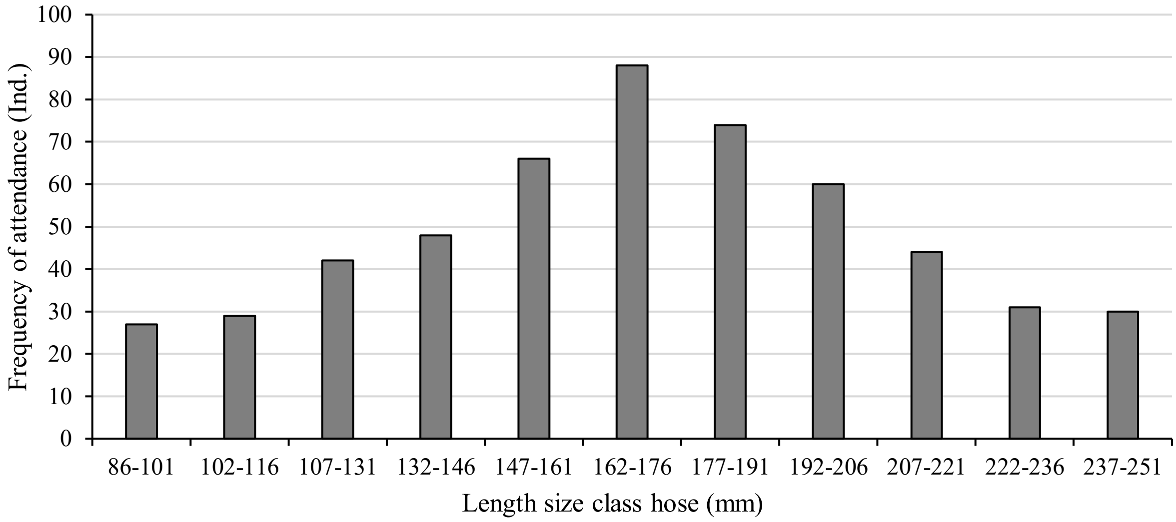


Figure 3. Frequency distribution of the total length of Greenback gauvina fish (*Bunaka gyrinoides*) in the Cikaso River.

Regression analysis highlights the relationship between the length and weight of Greenback gauvina fish, as indicated by the equation $W = 0.0014\ L^{2.0895}$, with a determination coefficient of 0.9613. Based on the relationship between the length and weight of Greenback gauvina fish, the value of b = 2.0895 was obtained, with further testing confirming that $b \neq 3$ (t-value> t-table) or $b < 3$. These results indicate that the growth pattern of Greenback gauvina fish is negative allometric, where the growth of fish length is more dominant than the growth of its weight (Figure 4).

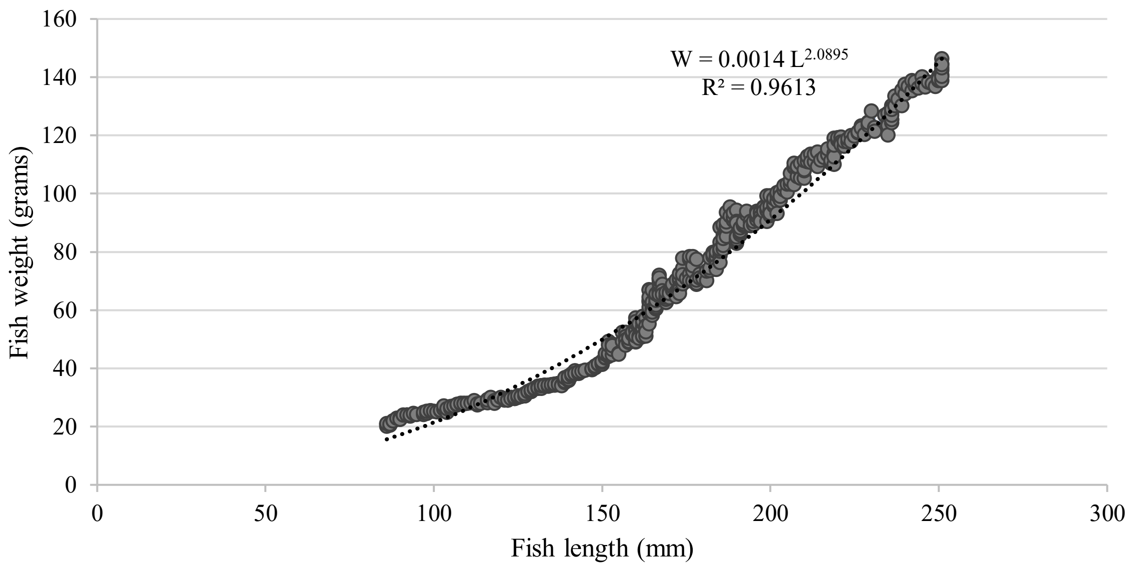


Figure 4. Length-weight relationship of Greenback gauvina fish in the Cikaso River

The condition factor of Greenback gauvina fish (*Bunaka gyrinoides*) ranges from 0.88 to 1.37. Fluctuations in the condition factor values occurred during the 2021 observations. The condition factor of the Greenback gauvina fish reached its highest value at the end of the transition season from the rainy season to the dry season in April. The condition factor of the

Greenback gauvina fish reached its lowest point during the transition from the dry season to the rainy season in August (Figure 5).

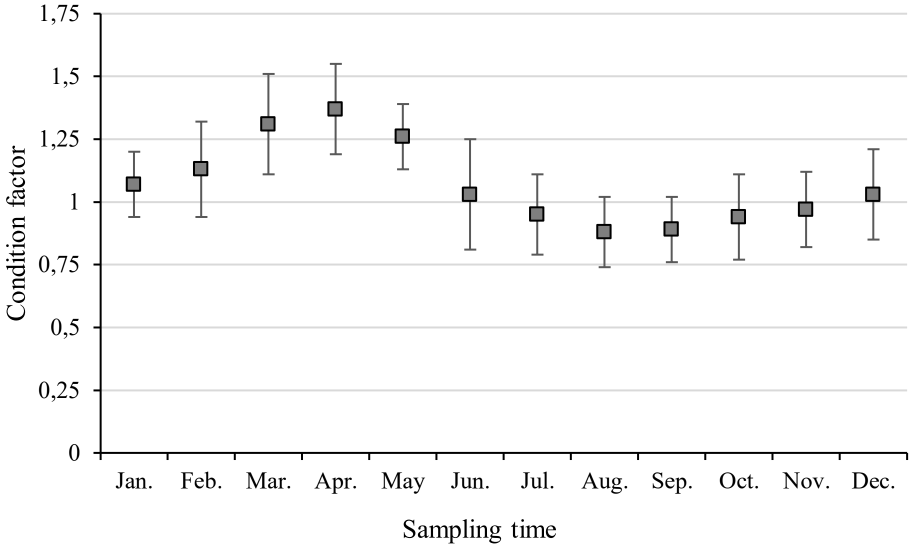


Figure 5. Condition factors of Greenback gauvina fish in the Cikaso River.

## DISCUSSION

A total of 539 Greenback gauvina fish (*Bunaka gyrinoides*) were collected throughout the year 2021 as part of the research. The fish's total length varied from 86 mm to 251 mm. The length distribution followed a unimodal pattern, with the most frequent size observed in the range of 162-176 mm (Figure 3). The unimodal curve reflects the normal distribution pattern of the individual fish sampled in this study (Heather *et al.,* 2025). This distribution pattern shows that the composition of the Greenback gauvina fish population caught is dominated by medium-sized individuals. The size class with the highest frequency indicates the dominance of a particular age group, which can be biologically associated with the juvenile or sub-adult phase in the fish's life cycle (Baihaqi *et al.,* 2025).

Regression analysis reveals a significant relationship between the length and weight of Greenback gauvina fish, represented by the equation $W = 0.0014\ L^{2.0895}$, with a coefficient of determination of 0.9613. This value indicates that 96.13% of the fish's weight growth is driven by its length growth. In other words, the remaining 3.87% of the weight growth is influenced by other factors, including diet, age, and environmental conditions (Baihaqi *et al.,* 2025). From the length-weight relationship, the value of $b = 2.0895$ was derived. Further analysis confirmed that $b \neq 3$ (t-value > t-table), suggesting that the growth pattern of Greenback gauvina fish is negative allometric, meaning the fish's length grows more significantly than its weight (Figure 4).

Several studies have demonstrated that growth patterns in particular fish species are influenced by various factors, including both intrinsic (biological) and extrinsic (environmental) factors, or a combination of both (Adinalda *et al.,* 2022; Nur *et al.,* 2023; Tesfaye *et al.,* 2023). From an intrinsic aspect, variations in growth patterns are related to different adaptive strategies in each species. In fish species with negative allometric characteristics, body length growth tends to be prioritized during the early stages of life, serving as a mechanism to increase mobility and avoid predators before an increase in body mass occurs. Fish in this category generally have a slender body shape and inhabit shallow waters with strong currents (Karachle & Stergiou, 2012; Riedel *et al.,* 2007; Torgersen *et al.,* 2023). From an extrinsic perspective, the tendency for negative allometric growth patterns can also reflect limited food resources or high levels of competition in their natural habitat. In such conditions, the energy obtained by fish is more directed towards maintaining survival and extending the body, rather than for accumulating energy reserves in the form of fat or muscle mass (Berneche & Allen, 2018; Perdana *et al.,* 2025).

The condition factor of Greenback gauvina fish (*Bunaka gyrinoides*) ranged from 0.88 to 1.37 throughout the observations in 2021. The values of the condition factor fluctuated during the year, with the highest recorded at the end of the transition from the rainy season to the dry season in April. Conversely, the lowest condition factor was observed during the shift from the dry season to the rainy season in August (Figure 5). The condition factor reflects the health and energy status of the fish, calculated based on its length and weight. In tropical waters, fish tend to have the highest condition factor during the transition from the rainy to the dry season and the lowest during the shift from the dry to the rainy season, due to various ecological and physiological factors (Asadi *et al.,* 2017; Ayoade & Ikulala, 2007; Keyombe *et al.,* 2017).

In terms of the availability of natural food sources, during the transition from the rainy season to the dry season, water discharge begins to decrease, resulting in calmer river currents. This can increase the concentration of benthic and planktonic organisms in the waters, which are sources of fish food (Baihaqi *et al.,* 2020; Rosmawati, 2011). Optimal feed availability enables fish to store more energy in the form of fat and protein, thereby increasing their condition factors (Xie *et al.,* 2021). Meanwhile, the transition to the rainy season usually brings an increase in water discharge and sedimentation, which can disrupt the riverbed ecosystem and reduce feed availability. Additionally, nutrient leaching and changes in water quality can induce physiological stress (Bilotta & Brazier, 2008; Hamid *et al.,* 2020; Soomro *et al.,* 2023).

When viewed from the reproductive phase, fish expend a significant amount of energy on reproductive activities, which typically intensify during or before the rainy season. Suppose the transition season to the rainy season coincides with the spawning phase. In that case, energy is diverted to reproduction rather than body growth, resulting in a decrease in the fish's condition factor. Conversely, after the spawning season ends (specifically, when the transition to the dry season occurs), fish begin to accumulate energy for body recovery, increasing muscle mass and energy reserves, thereby increasing their condition factor (Effendi, 2002; McBride *et al.,* 2015; Mu *et al.,* 2021).

Other ecological and physiological reviews are influenced by changes in the physical-chemical parameters of the water, typically occurring at the beginning of the rainy season, which is usually accompanied by drastic changes in temperature, pH, dissolved oxygen, and water turbidity levels. This can cause physiological stress in fish, which in turn affects their body condition. Meanwhile, as the dry season approaches, water quality parameters are usually more stable, providing a more supportive environment for growth and energy accumulation (Anh *et al.,* 2023; Chen *et al.,* 2023).

The mobility and habitat conditions of fish that change in both seasons can also be another cause. High water discharge at the beginning of the rainy season forces fish to migrate or seek shelter, thereby reducing their feeding time and increasing their energy expenditure. Conversely, when water discharge decreases, fish tend to settle and can access feeding zones more efficiently (Mangi, 2024; Winemiller & Jepsen, 1998).

## CONCLUSION

The greenback gauvina fish (*Bunaka gyrinoides*), found in the waters of the Cikaso River, Sukabumi, West Java, exhibited a negative allometric growth pattern, where the increase in body length was faster than the increase in body weight (b value < 3). The relationship between the length and weight of the fish can be explained by the equation $W = 0.0014\ L^{2.0895}$, with a coefficient of determination of 96.13%, indicating a strong relationship. The condition factor value of the Greenback gauvina fish in 2021 ranged from 0.88 to 1.37 and fluctuated between months. The highest value was recorded during the transition from the rainy season to the dry season. In contrast, the lowest value occurred during the transition from the dry season to the rainy season.

## ACKNOWLEDGEMENT

We would like to express our gratitude to the Cikaso River fishing business group, especially Mr. Kusnadi, who has helped with data collection activities.

## REFERENCES

Adinalda, M.G., & Sanjayasari, D. (2022). Growth Characteristic and Conditioning Factors of Mackerel Fish (*Scomberomorus commersonii*) Landed at PPI Cikidang Pangandaran West Java. *Jurnal Maiyah*, *1*(2), 102-109. Https://Doi.Org/10.20884/1.Maiyah.2022.1.2.6659.

Amaliah, S. W., Affandi, R., Simanjuntak, C. P. H., Baihaqi, F., Annida, S. B., Prabowo, T., & Romdon, A. (2023) Diet Composition and Feeding Strategy of Larvae and Juveniles of Green Riffle Goby, *Stiphodon Elegans* in Cimaja Estuary, Indonesia. *IOP Conf. Series: Earth and Environmental Science*, *1260*(1), Https://Doi.Org/10.1088/1755-1315/1260/1/012009.

Anh, N. T., Can, L. D., Nhan, N. T., Schmalz, B., & Luu, T. L. (2023). Influences of Key Factors on River Water Quality in Urban and Rural Areas: A Review. *Case Studies in Chemical and Environmental Engineering*, *8*(12), 1000424. Https://Doi.Org/10.1016/J.Cscee.2023.100424.

Annida, S. B., Zulkarnain, Wahju, R. I., Simanjuntak, C. P. H., Baihaqi, F., Prabowo, T., & Budiman M. S. (2021a). Fish Catches Diversity of The Glass Eel Fishery in Cikaso and Cimandiri Estuaries, Sukabumi, Indonesia. *E3S Web of Conferences*, *322*(03007), 1-11. Https://Doi.Org/10.1051/E3sconf/202132203007.

Annida, S.B., Apriliani, I.M., Baihaqi, F. (2021b). The Biological Aspects of The Main Targets of Troll Line at Palabuhanratu Fishing Port, Indonesia. *Asian Journal of Fisheries and Aquatic Research*, *13*(6), 19-25. Https://Doi.Org/10.9734/AJFAR/2021/V13i630281.

Annida, S. B., Zulkarnain, Wahju, R. I., Simanjuntak, C. P. H., & Purbayanto, A. (2022). Sintasan Pasca Penangkapan Hasil Tangkapan Perikanan Glass Eels di Estuari Sungai Cikaso, Sukabumi. *Jurnal Akuatika Indonesia*, *7*(1), 1-9. Https://Doi.Org/10.24198/Jaki.V7i1.37483.

Asadi, H., Sattari, M., Motalebi, Y., Zamani-Faradonbeh, M., & Gheytasi, A. (2017). Length-Weight Relationship and Condition Factor of Seven Fish Species from Shahrbijar River, Southern Caspian Sea basin, Iran. *Iranian Journal of Fisheries Sciences*, *16*(2), 733-741.

Ayoade, A. A., & Ikulala, A. O. O. (2007). Length Weight Relationship, Condition Factor and Stomach Contents of Hemichromis bimaculatus, Sarotherodon melanotheron and Chromidotilapia guentheri (Perciformes: Cichlidae) in Eleiyele Lake, Southwestern Nigeria. *Revista de biologia tropical*, *55*(3-4), 969-977. Http://Dx.Doi.Org/10.15517/Rbt.V55i3-4.5970.

Azrita, A., Syandri, H., & Aryani, N. (2024). Length and Weight Relationship, Condition Factor, and Morphometric Characteristics of Eleven Freshwater Fish Species in Koto Panjang Reservoir, Indonesia. *International Journal of Zoology*, *2024*(1), 9927705. Https://Doi.Org/10.1155/2024/9927705.

Baihaqi, F. (2022). Diversitas dan Kelimpahan Larva dan Yuwana Ikan Sebagai Dasar Pengelolaan Perikanan Amfidromus di Lima Estuari Sukabumi [*Thesis*]. Bogor: IPB University.

Baihaqi, F., & Annida, S.B. (2024). Selectivity of The Traps and Push Net Fishing Gear in The Glass Eels (*Anguilla* spp.) Capture Fishery in The Cikaso River Waters, Sukabumi, Indonesia. *International Journal of Contemporary Sciences*, *2*(1), 57-68. Https://Doi.Org/10.55927/Ijcs.V2i1.12292.

Baihaqi, F., & Annida, S. B. (2025). Sintasan Pasca Penangkapan Glass eels (*Anguilla* spp.) dari Wilayah Muara dan Sungai Cikaso, Sukabumi, Jawa Barat. *Jurnal Ruaya*. *13*.

Baihaqi, F., Annida, S. B., Nuraeni, N. F., Syafitri, A., & Ramadhani, U. S. (2025). Growth Patterns and Condition Factors of Crazy Fish (*Butis butis* Hamilton, 1822) in The Cikaso River, Sukabumi, Indonesia. *Egyptian Journal of Aquatic Biology & Fisheries*. *29*. Http://Dx.Doi.Org/10.21608/Ejabf.2025.428020.

Bahaqi, F., Krisanti, M., & Simanjuntak, C. P. H. (2020). Comparison of Zooplankton Community Structure in Sea Grass Ecosystems of Panggang and Semak Daun Islands, Kepulauan Seribu, Indonesia. *IOP Conf. Series: Earth and Environmental Science, 420*(1), 12005. Http://Dx.Doi.Org/10.1088/1755-1315/420/1/012005.

Berneche, D., & Allen, A.P. (2018). The Energetics of Fish Growth and How it Constrains Food-Web Trophic Structure. *Ecology Letters*, *21*(6), 836-844. Https://Doi.Org/10.1111/Ele.12947.

Bilotta, G. S., & Brazier, R. E. (2008). Understanding The Influence of Suspended Solids on Water Quality and Aquatic Biota. *Water Research*, *42*(12), 2849-2861. Http://Dx.Doi.Org/10.1016/J.Watres.2008.03.018.

Chen, Q., Li, Q., Lin, Y., Zhang, J., Xia, J., Ni, J., Cooke, S. J., Best, J., He, S., Feng, T., Chen, Y., Tonina, D., Benjankar, R., Birk, S., Fleischmann, A. S., Yan, H., & Tang, L. (2023). River Damming Impacts on Fish Habitat and Associated Conservation Measures. *Reviews of Geophysics*, *61*(4), 2023. Https://Doi.Org/10.1029/2023RG000819.

Dinh, Q. M., Nguyen, T. H. D., Truong, N. T., & Nguyen-Ngoc, L. (2022). Factors Regulating Growth Pattern and Condition Factor of an Amphibious Fish *Periophthalmus gracilis* Living in The Mekong Delta. *Peerj*. *10*(5), 13060. Http://Doi.Org/10.7717/Peerj.13060.

Dudgeon, D., Arthington, A. H., Gessner, M. O., Kawabata, Z. I., Knowler, D. J., Leveque, C., Naiman, R. J., Richard, A. H. P., Soto, D., Stiassny, M. L. J., Sullivan, C. A. (2006). Freshwater Biodiversity: Importance, Threats, Status and Conservation Challenges. *Biological Reviews of The Cambridge Philosophical Society*, *81*(2), 163-182.

Effendie, M. I. (2002). *Fisheries Biology*. Yogyakarta: Yayasan Pustaka Nusantara.

Froese, R. (2006). Cube Law, Condition Factor and Weight-Length Relationship: History, Meta-Analysis and Recommendations. *Journal of Applied Ichthyology*, *22*(4), 241-253. Https://Doi.Org/10.1111/J.1439-0426.2006.00805.X.

Gauvin, K. B., Lynch, A. J., Franklin, P. A., Reid, A. J., Landsman, S. J., Tickner, D., Dalton, J., Aarestrup, K., & Cooke, S. J. (2023). The Race for Freshwater Biodiversity: Essential Actions to Create The Social Context for Meaningful Conservation. *Conservation Science and Practice*, *5*(4), 12911. Https://Doi.Org/10.1111/Csp2.12911.

Hamid, A., Bhat, S. U., & Jehangir A. (2020). Local Determinants Influencing Stream Water Quality. *Applied Water Science*, *10*(1), 1-16. Https://Doi.Org/10.1007/S13201-019-1043-4.

Heather, F. J., Richards, S. A., Krueck, N. C., Stuart-Smith, R. D., Brandl, S. J., Casey, J. M., Edgar, G. J., Barrett, N., Parravicini, V., & Audzijonyte, A. (2025). Consistent Unimodal Body Length Distributions in Hundreds of Reef Fishes Across Diverse Life Histories. *Fish and Fisheries, 26*(4), 533-545. Https://Doi.Org/10.1111/Faf.12896.

Karachle, P. K., & Stergiou, K. I. (2012). Morphometrics and Allometry in Fishers. in Book: *Morphometrics*. Ed. Wahl, C. Intechopen. Https://Doi.Org/10.5772/2138.

Keyombe, J. L., Malala, J. O., Waithaka, E., Lewo, R. M., & Obwanga, B.O. (2017). Seasonal Changes in Length-Weight Relationship and Condition Factor of Nile Tilapia, *Oreochromis niloticus* (Linnaeus, 1758) (Cichlidae) in Lake Naivasha, Kenya. *International Journal of Aquatic Biology*, *5*(1), 7-11.

Mangi, H. O. (2024). Water Level Fluctuation Effect on Fish Reproduction Success. *International Journal of Ecology*, *2024*(1), 4876582. Https://Doi.Org/10.1155/2024/4876582.

Mcbride, R. S., Somarakis, S., Fitzhugh, G. R., Albert, A., Yaragina, N. A., Wuenschel, M. J., Alonso-Fernandez, A., & Basilone, G. (2015). Energy Acquisition and Allocation to Egg Production in Relation to Fish Reproductive Strategies. *Fish and Fisheries*, *16(*1), 23-57. Http://Dx.Doi.Org/10.1111/Faf.12043.

Mu. X., Zhang, C., Xu, B., Ji, Y., Xue, Y., & Ren, Y. (2021). Accounting for The Fish Condition in Assessing The Reproductivity of A Marine Eel to Achieve Fishery Sustainability. *Ecological Indicators*, *130*(1), 108116. Https://Doi.Org/10.1016/J.Ecolind.2021.108116.

Niawati, N. C., & Putriani, R. B. (2024). Growth Pattern and Condition Factors of Kurisi Fish (*Nemipterus nematophorus*, Russel 1990) Landed at Lempasing Fishing Port. *Florea: Jurnal Biologi dan Pembelajarannya, 11*. Https://Doi.Org/10.25273/Florea.V11i2.21305.

Nur, M., Tenriware, & Nasyrah A. F. A. (2023). Length-Weight Relationship and Condition Factor of Bullet Tuna (*Auxis rochei* Risso, 1810) in The Waters of Mamuju District, West Sulawesi Province, Indonesia. *Biodiversitas* *24*(10). Https://Doi.Org/10.13057/Biodiv/D241005.

Nurfadillah, N., Dewiyanti, I., Yunus, M., Mellisa, S., & Octavina, C. (2021). Analysis of Primary Productivity and Trophic Status of Kuala Gigieng Waters Aceh Besar for Sustainable Fisheries Management. *IOP Conf. Series: Earth and Environmental Science*, *869*(1), 12044. Https://Doi.Org/10.1088/1755-1315/493/1/012020.

Omar, S. B. A., Kariyanti, Yanuarita, D., Umar, M. T., & Lawi, Y. S. I. (2020). Length-Weight Relationship and Condition Factor of Celebes Rainbowfish *Marosyherina Ladigesi* Endemic to The Maros Karst Region. *AACL Bioflux*, *13*.

Oyebola, O. O., Omitoyin, S. B., Hounhoedo, A. O. O., & Agadjihouèdé, H. (2022). Length-Weight Relationship and Condition Factor Revealed Possibility of Mix Strains in *Clarias gariepinus* Population of Oueme Valley, Benin Republic (West Africa). *Total Environment Research Themes,* *4*(3), 100009. Https://Doi.Org/10.1016/J.Totert.2022.100009.

Perdana, A. W., Maghfiriadi, F., Maulizar, S., Julismi, A., Dawami, M., & Nur, F. M. (2025). Growth Patterns and Condition Factors of Fish in The Celike River, Leuser Ecosystem Area, East Aceh, Indonesia. *Bio Web of Conferences*, *156*(1), 3038. Https://Doi.Org/10.1051/Bioconf/202515603038.

Riedel, R., Caskey, L. M., & Hurlbert, S. H. (2007). Length-Weight Relations and Growth Rates of Dominant Fishes of The Salton Sea: Implications for Predation by Fish-Eating Birds. *Lake and Reservoir Management*, *23*(5), 528-535. Https://Doi.Org/10.1080/07438140709354036.

Rosmawati, T. (2011). *Aquatic Ecology*. Jakarta: Hiliana Press.

Simanjuntak, C. P. H., Baihaqi, F., Prabowo, T., Annida, S. B., Sulistiono, & Ervinia, A. (2021). Recruitment Patterns of Freshwater Amphidromous Fishes (Pisces: Gobiidae, Eleotridae) to The Cimaja Estuary, Palabuhanratu Bay. *Jurnal Iktiologi Indonesia*, *21*(3), 321-337. Https://Dx.Doi.Org/10.32491/Jii.V21i3.595.

Soomro, S., Shi, X., Guo, J., Ke, S., Hu, C., Asad, M., Jalbani, S., Zwain, H. M., Khan, P., & Boota, M. W. (2023). Are Global Influences of Cascade Dams Affecting River Water Temperature and Fish Ecology?. *Applied Water Science*, *13*(4), 106. Https://Doi.Org/10.1007/S13201-023-01902-9.

Tesfaye, M., Souza, A.T., Soukalova, K., Smejkal, M., Hejzlar, J., Parchalova, M., Riha, M., Muska, M., Vasek, M., Frouzova, J., Blabolil, P., Boukal, D. S., & Kubecka, J. (2023). Somatic Growth of Pikeperch (*Stizostedion lucioperca*) in Relation to Variation in Temperature and Eutrophication in A Central Europe Lake. *Fisheries Research*, *267*(3), 106824. Https://Doi.Org/10.1016/J.Fishres.2023.106824.

Torgersen, K. T., Bouton, B. J., Hebert, A. R., Kleyla, N. J., Plasencia, X., Rolfe, G. L., Tagliacollo, V. A., & Albert, J. S. (2023). Phylogenetic Structure of Body Shape in A Diverse Inland Ichthyofauna. *Science Report*, *13*(1), 20758. Https://Doi.Org/10.1038/S41598-023-48086-5.

Walpole, R. E. (1995). *Introduction of Statistics* 3rd Edition. Jakarta: PT Gramedia Pustaka Utama.

Winemiller, K. O., & Jepsen, D. B. (1998). Effects Of Seasonality and Fish Movement on Tropical River Food Webs. *Journal of Fish Biology*, *53*(1), 267-296. Http://Dx.Doi.Org/10.1111/J.1095-8649.1998.Tb01032.X.

Xie, R., Amenyogbe, E., Chen, G., & Huang, J. (2021). Effects of Feed Fat Level on Growth Performance, Body Composition and Serum Biochemical Indices of Hybrid Grouper (*Epinephelus fuscoguttatus* × *Epinephelus polyphekadion*). *Aquaculture*, *530*(1), 735813. Https://Doi.Org/10.1016/J.Aquaculture.2020.735813.