Proceedings of the 10th International Conference on Fisheries and Aquaculture, Vol. 10, Issue 1, 2023, pp. 13-20

ISSN 2386-1282 online
DOI: https://doi.org/10.17501/23861282.2023.10102

A STUDY ON THE LENGTH-WEIGHT RELATIONSHIPS AND CONDITION FACTOR OF BALI SARDINELLA, IN BALI STRAIT, INDONESIA

Sari IP, Larasati RF*, Jaya MM, Khikmawati LT, Satyawan NM, Tanjov YE, Mainnah M, Aziz MA, Suhery N, Sarasati W and Suratna

Capture Fisheries Department, Marine and Fisheries Polytechnic of Jembrana, Bali, Indonesia

Abstract: The Bali sardinella (Sardinella lemuru) from 'PPN Pengambengan' in Bali Strait, Indonesia, has a high commercial value and is under pressure from fishing, despite the fact that the fish growing state is poorly understood. The goal of this study is to discover numerous elements of Bali sardinella growth, such as size distribution, length-weight relationship (LWRs), condition factors, and growth patterns. A total of 817 Bali sardinella fish with lengths ranging from 105-210 mm were sampled in order to determine the length-weight relationship (LWRs) and condition factors. Local fishermen primarily caught them with purse seines (mesh size 0.75 inch). According to the findings, the Bali sardinella (both female and male) growth allometrically (b=2.8656-2.9367), showing that the fish gets slimmer as it grows longer. There was no difference in the percentage of capture numbers between males and females, nor in the condition factor (k) ($p>0.05$). Male and female mean k values were 0.9672±0.0396 and 0.9912±0.0670, showing that the Bali sardinella are in good condition.

Keywords: allometric growth, condition factor, *Sardinella lemuru*

Introduction

The Bali sardinella (Sardinella lemuru) from 'PPN Pengambengan' in Bali Strait, Indonesia, has a high commercial value and is under pressure from fishing, despite the fact that the fish growing state is poorly understood. Purse seine fishing business at the 'PPN Pengambengan' has turned towards commercial ventures for get the maximum profit, namely by enlarging the size and power of the ship's engine and looking for fishing areas further from the fishing business base. Currently, Bali sardinella captured with a purse seine tend to disregard the principles of fish resource sustainability maintain the survival of fisheries enterprises, thus the tendency of catching small and immature fish persists.

In biological fishing, the lengt-weight relationship (LWRs) and condition factors is a significant indicator. The LWRs can be used to discriminate between taxonomic units and to calculate condition factors. Each species will have a distinct length-weight relationship. The relationship between length and weight is further altered by sex differences within species and across stocks (Hossain et al. 2017; Ahmed et al. 2011). The LWRs and condition factors are important in fishery assessment studies because they provide information about the fish's growth, overall well-being, and fitness in a marine ecosystem. (Jisr et al. 2018). Meanwhile, condition factors are used to compare the welfare of a

*Corresponding Author's Email: rakhmafitrialarasati@gmail.com

species among populations. Several factors, including food availability and environmental fluctuations, influence condition factors (Rodriguez et al., 2017).

The goal of this study is to discover numerous elements of Bali sardinella growth, such as size distribution, length-weight relationship (LWRs), condition factors, and growth patterns. The Bali sardinella was obtained from 'PPN Pengambengan' Bali Strait, Indonesia, and this study gives the first basic information on length-weight characteristics for the species. This study has added to our understanding of Indonesia's Bali Strait's sustainable fishing resources.

Materials and Methods

January through July 2023 saw the study's execution, a total of 817 Bali sardinella were taken from 'Pelabuhan Perikanan Nusantara (PPN) Pengambengan' in Bali Strait, Indonesia (Fig. 1) by local fishermen using purse seine (mesh size 0.75 inch). To take varied lengths, samples were measured using a ruler with ±1 mm accuracy, and body weight was recorded using an electronic balance with ±1 g accuracy.

The length-weight relationship (LWRs) was determined using the least squares approach (Erguden & Turan 2011) Y= a+bX; where Y = body weight, X = total length, a = proportionality constant, and b = regression coefficient. The LWRs were calculated using the equation $W= aL^b$ (Le Cren 1951; Effendie 1979; Froese 2006), where W= weight of fish (g), L= total length of fish (mm), a= constant (intercept), and b= constant (regression line slope). The 'a' and 'b' parameters were derived using natural logarithms in linear regression studies as ln W = ln (a) + b ln (L). Condition factor was computed using t-test, performed on b values to find out whether b=3 as isometric growth or b≠3 as allometric growth. Condition factor for isometric growth using the formula (Effendi 1979) equation: $k=(10^5W)/L^3$ and $k=W/(aL^b)$ for allometric growth. MS.Excel was used for all statistical analyses, with a 5% level of significance ($p<0.05$).

Results and Discussion

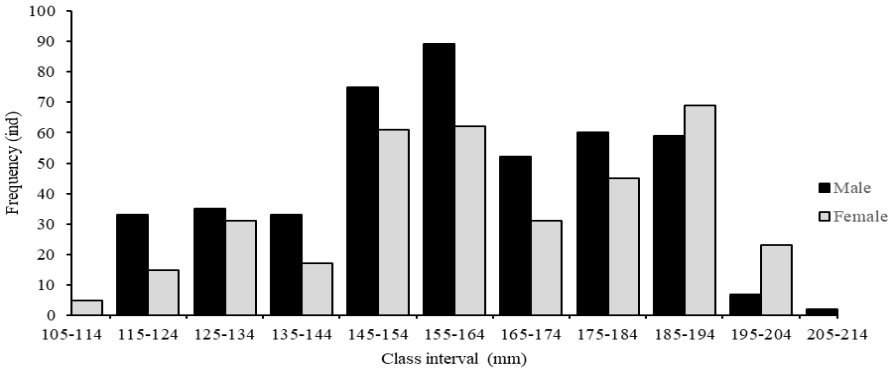

Figure.1. Showing frequency in the class interval (total length fish in mm) from Bali sardinella

The computational length-weight relationship revealed that females had the highest coefficient of correlation values (r) for length and weight, with values female and male of 0.92 and 0.91, respectively (Fig. 2 and 3). The length-weight relationships of all fish species (male and female) exhibited a more significant positive correlation.

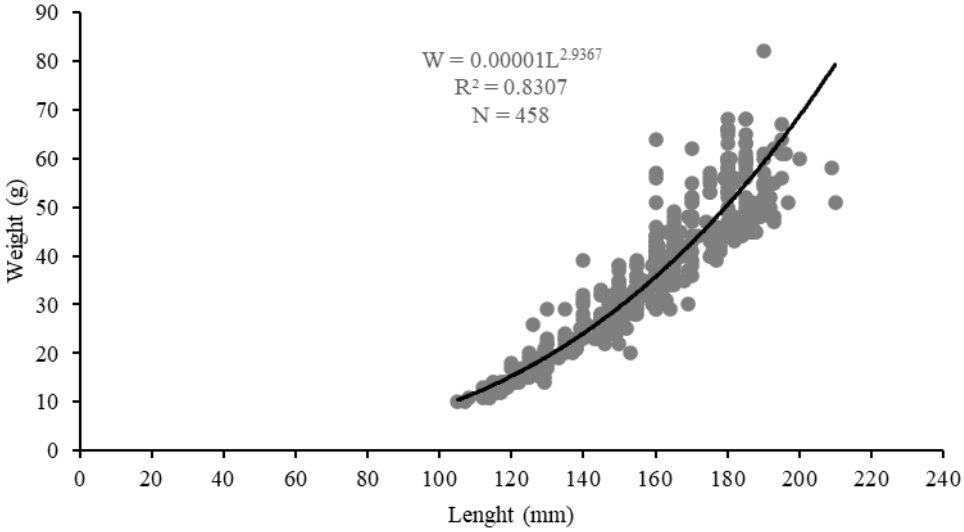

Figure 2. Showing length-weight relationships from Bali sardinella (male)

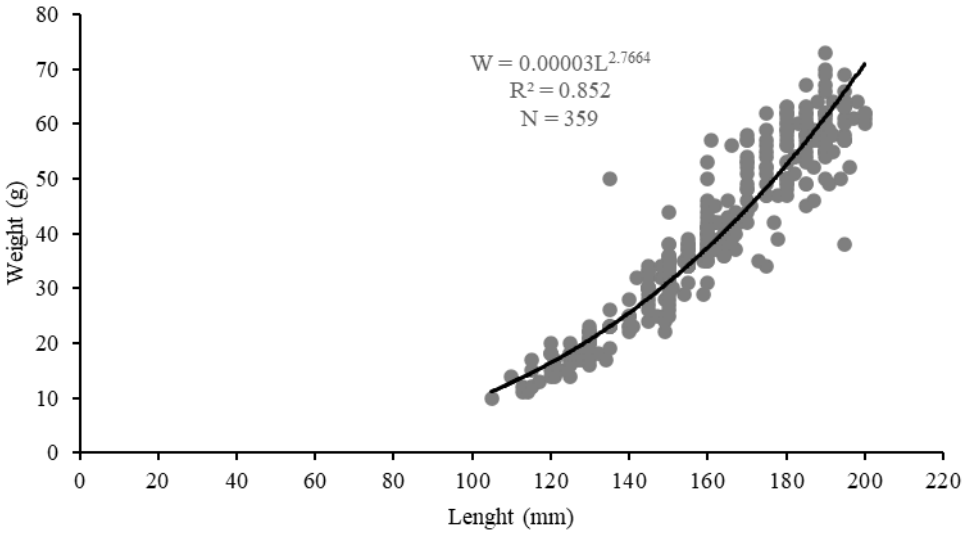

Figure 3. Showing length-weight relationships from Bali sardinella (female)

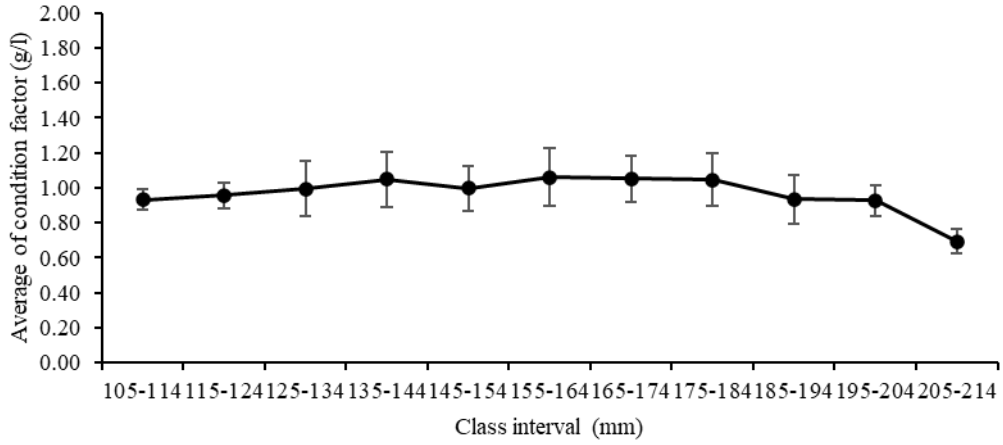

Figure 4. Showing average of condition factor from Bali sardinella (male)

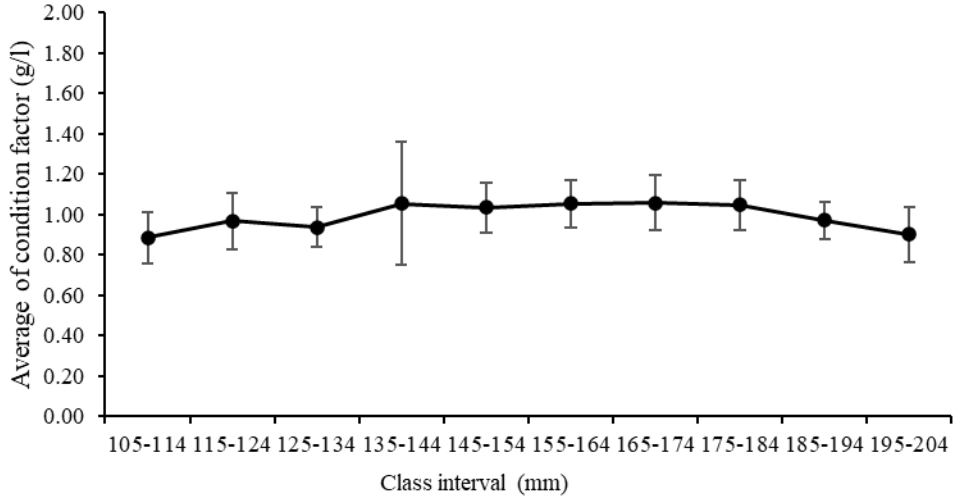

Figure 5. Showing average of condition factor from Bali sardinella (female)

The overall length range of Bali Sardine fish taken between January and July 2023 is discovered to be between 105-210 mm (Fig. 2), with a weight range of 10-82 g. The most commonly caught fish varied in total length class intervals of 155-164 mm. The LWRs for male fish is $W=0.00001L^{2.9367}$ and for females is $W=0.00003L^{2.7664}$, with correlation coefficient (r) values of 0.91 and 0.92, respectively (Fig. 2 & 3). If the correlation coefficient (r) is within the range of -1 or 1, there is a strong linear correlation between the two variables (Walpole, 1993). This suggests that the length and weight of Bali sardinella in the 'PPN Pengambengan' have a strong correlation of roughly 80-90%.

The LWRs of the collected fish has a determinant value (R^2) of 0.8307 for males and 0.852 for female Bali sardinella. Value (R^2) of the LWRs of Bali Sardine that collected relatively large enough, the magnitude of the value is close to 1, indicating that the diversity which is influenced by other variables is quite small and total length and fish weight have a very strong and tight relationship. By comparing the b values from the t-test analysis, the assumption of growth patterns can be identified.

When an organism's weight increases faster than its length (b>3), this is referred to as positive allometric growth, whereas negative allometric growth happens when an organism's length increases faster than its weight (b<3) (Wootton 2012). Despite a variety of influential factors such as sex, health condition, gonad maturation, and age, as well as external factors such as seasonality, habitat, geographic region, sample size, and collection and preservation process. On this study demonstrating negative allometric growth for Bali sardinella (male and female). Negative allometric growth pattern suggests that the food supply in the waters is insufficient, hence length growth is more dominating than weight growth (Effendi 1997; Silaban et al. 2021; Utami et al. 2022). Previous research on lemuru fish at 'PPN Muncar Banyuwangi' also yielded a value of b<3, or 2.7677, displaying an allometric pattern that is negative (Putra et al. 2020).

The value of the LWRs parameter 'b' was within the advised range of 2.5-3.5 (Froese 2006; Faradonbeh et al. 2015; Keivany et al. 2015; Sheikh & Ahmed 2019; Hossen et al. 2020). These study's b values for Bali sardinella varied between female and male, with 2.7664 and 2.9367. Male fish have a greater condition factor than female fish because female fish invest more energy in gonadal development. (Mayekiso & Hecht 1990; Bengkal & District 2022). Higher regression b values as a result, the slope demonstrated that a particular species' LWRs obeyed the cube law. The general health of the fish's appetite and gonad content is indicated by high b values. (Pervin & Mortuza 2008). Fish gain weight when they eat the available food for development and energy (Kamaruddin et al. 2012; Offem et al. 2007). Sex, growth stage, stomach contents, and gonad development are other variables that affect the values (Hossain et al. 2006; Leunda et al. 2006; Pervin & Mortuza 2008). Furthermore, biological and environmental circumstances, as well as geographical, chronological, and sampling parameters, influence b values (Bagenal & Tesch 1978; Froese 2006). These aspects, however, were disregarded due to time and financial constraints. Before proceeding, more extensive investigations, the biology of the fishes must be understood, as well as the standardisation of sampling sizes, depths, and seasons.

The condition factor is a a state that expresses plumpness fish by numbers (Effendie 1997). The average condition factor value for male fish is 0.9672 and female fish is 0.9912 (Fig. 3 & 4). The condition factor's worth in terms might represent the state of the aquatic environment that supports fish growth (Napisah & Machrizal 2021; Nasution & Machrizal 2021). Food availability might have an impact on condition factors (Effendie 1997; Ekanem 2004; Mulfizar et al. 2012; Muthmainnah 2013; Radongkir et al. 2018). Utilising length frequency, the LWRs simultaneously evaluates the condition factor of the fish species and fish biomass. The condition factor is used in fisheries science to compare the "condition," "fatness," or "wellbeing" of fish. The idea behind it is that larger, heavier fish of a particular length have greater physiological health (Bagenal & Tesch 1978). The condition

factor can also be used to track the intensity of feeding, age, and growth rates in fish. If there is a sudden change in the state of the fish in a body of water, such a situation permits it to be explored. If conditions are poor, the population may be overly dense; conversely, if conditions are excellent and food sources are plentiful, the fish that occupy this area may be fat or plump.

Conclusion

Bali sardinella (both female and male) growth allometrically, showing that the fish gets slimmer as it grows longer. There was no difference in the percentage of capture numbers between males and females, nor in the condition factor showing that the Bali sardinella are in good condition.

Acknowledgements

The study was performed with financial support from the Marine and Fisheries Polytechnic of Jembrana, Bali in 2023.

Declaration of Interest Statement

The authors declare that they have no conflict of interests.

References

Ahmed, E. O., Ali, M. E., & Aziz, A. A. (2011). Length-weight relationships and condition factors of six fish species in Atbara River and Khashm El-Girba Reservoir, Sudan. *International Journal of Agriculture Sciences*, *3*(1), 65-70.

Bagenal, T.B., & Tesch, F.W. (1978). Age and growth. In Methods for Assessment of Fish Production in Fresh Waters. 3rd ed., edited by Bagenal, T.B. Oxford: Blackwell Scientific Publications. pp. 101-136.

Bengkal, M., & District, M. A. S. (2022). Study on the aspect of fish growth at Inland Waters of East Kutai Regency. *Jurnal Ilmu Perikanan Tropis Nusantara*, 1(1).

Effendie, M. I. (1997). Fisheries Biology. Yogyakarta, ID: Yayasan Pustaka Nusantara.

Ekanem, S.B. (2004). The biology and culture of the silver catfish (*Chrysichthys nigrodigitatus*). *Journal of Sustainable Tropical Agricultural Research*, 10, 1-7.

Erguden, D., Turan, F., & Turan, C. (2011). Length–weight and length–length relationships for four shad species along the Western Black Sea Coast of Turkey. *Journal ofApplied Ichthyology*, 27(3), 942-944.

Faradonbeh, M. Z., Eagderi, S., & Ghojoghi, F. (2015). Length-weight relationship and condition factor of seven fish species of Totkabon River (southern Caspian Sea basin), Guilan, Iran. *International Journal of Aquatic Biology*, *3*(3), 172-176.

Froese, R. (2006). Cube law, condition factor and weight– length relationships: history, meta-analysis and recommendations. *Journal of Applied Ichthyology*, 22(4), 241-253.

Hossain, M. Y., Hossen, M. A., Khatun, D., Nawer, F., Parvin, M. F., Rahman, O., & Hossain, M. A. (2017). Growth, condition, maturity and mortality of the gangetic leaf fish nandus nandus (Hamilton, 1822) in the Ganges River (Northwestern Bangladesh). *Jordan Journal of Biological Sciences*, *10*, 57-62.

Hossain, M.Y., Ahmed, Z.F., Leunda, P.M., Jasmine, S., Oscoz, J., Miranda, R. & Ohtomi, J. (2006). Condition, length-weight and length-length relationships of the asian striped catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Mathabhanga River, Southwestern Bangladesh. *Journal of Applied Ichthyology*, 22, 304-307.

Hossen, M. A., Hossain, M. Y., Khatun, D., Pramanik, M. N. U., Parvin, M. F., Jasmin, J., ... & Hasan, M. R. (2020). Morphometric and meristic traits of three ambassid fish species (*Chanda nama, Parambassis lala* and *Parambassis ranga*). *Indian Journal of Geo-Marine Sciences*, 49(3), 398-405.

Jisr, N., Younes, G., Sukhn, C., & El-Dakdouki, M. H. (2018). Length-weight relationships and relative condition factor of fish inhabiting the marine area of the Eastern Mediterranean city, Tripoli-Lebanon. *The Egyptian Journal of Aquatic Research*, 44(4), 299-305.

Kamaruddin, I.S., Mustafa-Kamal, A.S., Christianus, A., Daud, S.K., Amin, S.M.N. & Yu-Abit, L. (2012). Length-weight relationship and condition factor of three dominant species from the Lake Tasik Kenyir, Terengganu, Malaysia. *Journal of Fisheries and Aquatic Science*, 6(7), 852-856.

Keivany, Y., Nezamoleslami, A., Dorafshan, S., & Eagderi, S. (2015). Length-weight and length-length relationships in populations of garra rufa from different rivers and basins of Iran. *International Journal of Aquatic Biology*, *3*(6), 409-413.

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, 201-219.

Leunda, P.M., Oscoz, J., & Miranda, R. (2006). Length-weight relationships of fishes tributaries of the Ebro River, Spain. *Journal of Applied Ichthyology*, 22, 299-300.

Mayekiso M, Hecht T. (1990). The feeding and reproductive biology of a South African Anabantid fish *Sandelia bainsii*. *Revue d'Hydrobiologie Tropicale*, 23(3), 219-230.

Muthmainnah, D. (2013). Relationship between length and weight and condition factors of snakehead fish (*Channa striata* Bloch, 1793) raised in Lebak Swamp, South Sumatra Province. *Depik*, *2*(3).

Napisah, S., & Machrizal, R. (2021). The relationship of length - weight and condition factors of fish gulamah (*Johnius trachycephalus*) in River Waters Barumun Labuhanbatu District. *Bioscientist: Jurnal Ilmiah Biologi*, *9*(1), 63-71.

Nasution, S. Y., & Machrizal, R. (2021). Condition factors and length - weight relationship of spur fish (*Hexanematichthys sagor*). *BIOEDUSAINS: Jurnal Pendidikan Biologi Dan Sains*, 4(2), 386-392.

Offem, B.O., Akegbejo-Samsons, Y. & Omoniyi, I.T. (2007). Biological assessment of *Oreochromis niloticus* (Pisces: Cichlidae: Linne, 1958) in a tropical floodplain river. *African Journal of Biotechnology*, 6, 1966-1971.

Pervin, M.R. & Mortuza, M.G. (2008). Notes on length-weight relationship and condition factor of freshwater fish, labeo boga (Hamilton) (Cypriniformes: Cyprinidae). *University Journal of Zoology Rajshahi University*, 27, 97-98.

Putra, I. N. S. A., Restu, I. W., & Ekawaty, R. (2020). Study of landed lemuru fish (*Sardinella lemuru*) stocks at the Muncar Coastal Fishing Port, Regency Banyuwangi, East Java Province. *Current Trends in Aquatic Science*, *3*(1), 30-38.

Radongkir, Y. E., Simatauw, F., & Handayani, T. (2018). Growth aspects of scad decapterus macrosoma on fish point Sanggeng-Manokwari Regency. *Jurnal Sumberdaya Akuatik Indopasifik*, *2*(1), 15-24.

Rodriguez, C., Galli, O., Olsson, D., Tellechea, J. S., & Norbis, W. (2017). Length-weight relationships and condition factor of eight fish species inhabiting the Rocha Lagoon, Uruguay. *Brazilian Journal of Oceanography*, 65, 97-100.

Sheikh, Z.A. & Ahmed, I. (2019). Length weight relationship of seven indigenous fish species of Kashmir Himalaya,India. *Iranian Journal of Ichthyology*, 6(3), 240-243.

Silaban, R., Silubun, D. T., & Jamlean, A. A. R. (2021). Ecological aspects and growth of feather shells (*Anadara antiquata*) in Letman Waters, Southeast Maluku Regency. *Jurnal Kelautan: Indonesian Journal of Marine Science and Technology*, 14(2), 120-131.

Utami, R. T., Ibrahim, P. S., Kusnadi, A., Kurnianto, D., Triandiza, T., & Pesillette, R. N. (2022). Length-Weight relationships and condition factors of *Rochia nilotica* in Maluku, Sumbawa, and Bengkulu. *Jurnal Kelautan Tropis November*, 25(3), 320-328.

Walpole, R. E. (1993). Introduction to Statistics. Jakarta, ID: PT. Gramedia Pustaka Utama.

Wootton, R. J. (2012). Ecology of Teleost Fishes. Springer Science & Business Media.