Journal of Management Science (JMAS)
Volume 6, No. 4, October 2023, pp 783-789 ISSN 2684-9747 (Online)
www.exsys.iocspublisher.org/index.php/JMAS Published by: Institute of Computer Science (IOCScience)

Length-weight relationship and cluster analysis in puntius bulu: applications in fisheries management

Andri Hendrizal[1], Muhammad Fauzi[2]

[1,2]Aquatic Resources Management Department, Faculty of Fisheries and Marine Science, Universitas Riau, Pekanbaru, Indonesia

ARTICLE INFO

Article history:

Received Jul 24, 2023
Revised Oct 25, 2023
Accepted Oct 30, 2023

Keywords:

Cluster Analysis;
Fishery Management;
Species Diversity;
Stock Assessment.

ABSTRACT

This study aimed to explore the relationship between the length and weight of Subhan fish (*Puntius bulu*) and to identify cluster structure in populations based on various variables. Descriptive and exploratory analyses were performed on 51 fish samples measured for total length, raw length, total weight, total gonadal weight, sex, and gonad maturity level. The relationship between fish length and weight was found to be strong, reflecting growth patterns common in many fish species. In addition, cluster analysis revealed the presence of two distinct groups of fish in the population, which may reflect differences in life cycle stages, environmental conditions, or life strategies. These results have significant implications in fisheries management, including stock assessment, capture planning, and conservation.

Corresponding Author:

Andri Hendrizal,
Department of Aquatic Resources Management,
Universitas Riau,
HR Subrantas KM 12,5 Simpang Baru, Pekanbaru, 28293, Indonesia.
Email: andri.h@lecturer.unri.ac.id

1. Introduction

Subhan fish (*Puntius bulu*) are a valuable species of freshwater fish that play an important role in the aquatic ecosystems in which they live. In addition, they are also an important source of animal protein for humans, especially for communities around the waters where they are found (Japning & Esa, 2005; Lim & Furtado, 1986) Due to their important role in ecosystems and as food sources, a deep understanding of fish biology and ecology is essential(Elvince & Aunurafik, 2020; Risti et al., 2019) One important aspect of biology is the relationship between fish length and weight, which can provide important insights into fish growth and health conditions(Branenda et al., 2020; Nurhayati et al., 2016; Puspita et al., 2021; Ramadhani et al., 2017; Risti et al., 2019)

Knowledge of fish length-weight relationships can provide valuable information on various aspects of fisheries management. For example, a length-weight relationship can be used to determine the optimal harvest size to maximize yield while minimizing negative effects on fish populations (Arif Habib Fasya & Mufidah F, 2022; Hasan & Afriani, 2021; Karel et al., 2020; Sinaga & Afriani, 2020). In addition, knowledge of the length-weight relationship is also important in fish stock assessment, where it is often difficult to measure fish weight directly(Puspita et al., 2021), and in these cases, length measurements can be used to estimate weight.

However, although knowledge of the length-weight relationship is important, there is still a knowledge gap regarding this relationship in many fish species, including the Subhan fish. Therefore, further research is required to understand this relationship in this species.

This knowledge gap also includes a lack of understanding of how length-weight relationships might differ between different fish populations or under different environmental conditions (Kuriakose, 2017; Olentino et al., 2023; Rojas et al., 2021). For example, environmental factors such as temperature, water quality, and food availability can affect fish growth and conditions, and therefore, can affect length-weight relationships(Hasan

& Afriani, 2021). Therefore, this study aimed to not only understand the length-weight relationship in Subhan fish in general, but also to explore how this relationship might differ in different contexts.

In addition, although the length-weight relationship is an important indicator of fish growth conditions and strategies, it cannot be fully understood without considering other factors that might affect fish growth and conditions. Therefore, this study will also try to understand the length-weight relationship in a broader context, taking into account other factors, such as sex and degree of gonadal maturity(Branenda et al., 2020; Marasabessy, 2020).

Therefore, this study aimed to determine the length-weight relationship of Subhan fish (*Puntius bulu*) and how this relationship is influenced by factors such as sex and gonad maturity level. The study also aimed to explore how length-weight relationships might differ in different contexts, taking into account environmental factors that might influence fish growth and conditions. The results of this study are expected to make an important contribution to scientific knowledge about Subhan fish and provide valuable insights for sustainable fisheries management.

2. Research Method

This study was designed to determine the relationship between the length and weight of Subhan fish (*Puntius bulu*). The research method involved the following stages.

Data Collection: At this stage, the Subhan fish were collected from several locations in their natural habitat. Fishing will be performed using nets and other appropriate fishing methods to ensure that different sizes and sexes of fish are represented in the sample. Next, the total length and weight of each caught fish was measured. The length was measured from the tip of the snout to the tip of the caudal fin (total length), while weight was measured using a digital scale (Dulčić & Kraljević, 1996; Santos et al., 2002).

Data Analysis: Data on the length and weight of fish will be analyzed to determine the relationship between the two variables. This analysis was performed using linear regression, where the length of the fish was used as the independent variable and the weight of the fish as the dependent variable. The results of this analysis provide regression models that explain the relationship between the length and weight of fish, as well as the value of the coefficient of determination that shows the extent to which variability in fish weight can be explained by their length.

3. Results And Discussions

Data Distribution

The results of the descriptive analysis showed that 51 fish samples had variations in size, weight, sex, and degree of gonadal maturity. The total length of the fish ranged from 80 cm to 162 cm, with an average of 127.69 cm and most fish had a length between 120 cm and 132 cm. The raw length of fish also showed variations, with values ranging from 57 cm to 132 cm and an average of 98.04 cm, and most fish had a raw length of 92–102 cm.

The total weight of the fish showed greater variation, ranging from 4.45 g to 63 g, with an average of 30.4 g. Most fish weigh between 22.25 g and 33.5 g. g, ranging from 0.03 g to 5.78 g with an average of 1.02 g, and most fish weighed between 0.15 g and 1.69 g.

The most common sex was female, with a frequency of 35 of 51 samples. The most common degree of gonadal maturity is II, with a frequency of 16, followed by levels III and V with frequencies of 12 and 11, and levels I and IV with frequencies of 7 and 5, respectively.

The results of this study provide an in-depth picture of the characteristics of the Subhan fish (Puntius bulu) in various aspects, including size, weight, sex, and degree of gonad maturity. The variability in these data reflects the natural diversity of Subhan fish populations and suggests that factors such as age, sex, and season can influence fish growth and development (Nasution & Machrizal, 2021; Ramadhani et al., 2017).

The relationship between fish length and weight has long been recognized as an important indicator of growth conditions and strategies (Mohamad Radhi et al., 2018; Musingi et al., 2020). In this study, significant variations were found in the length and weight of the Subhan fish, reflecting variations in the growth and development of individuals in the population. The fact that most fish have a length and weight within a certain range indicates that there are optimal conditions for the growth of Subhan fish, which can be used as a reference in fisheries management.

The most common degree of gonadal maturity was level II, followed by levels III and V. This suggests that most of the fish in the sample were in the early to intermediate stages of their reproductive cycles. This level of gonadal maturity can provide important information about the reproductive cycle and development

strategy of Subhan fish, and this can be used for information on determining optimal fishing times in fisheries management (Elvince &; Aunurafik, 2020).

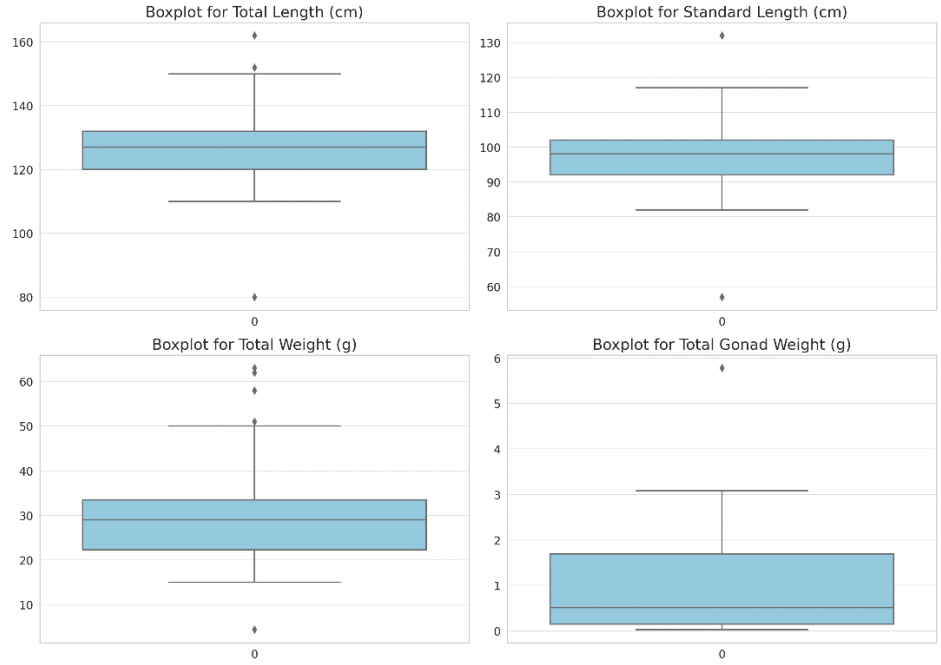

Figure 1. Distribution of Total Weight, Raw Length, Total Weight and Total Weight of Gonads

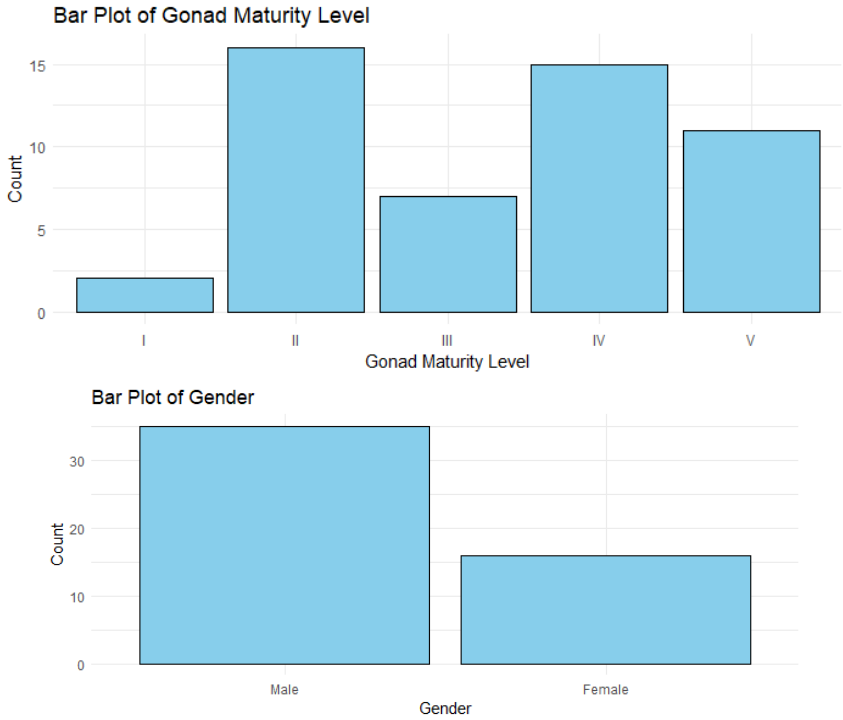

Figure 2. Distribution of the number of males and females and the degree of maturity of the gonads

From the graph above, there are several different levels of gonadal maturity, namely, I, II, III, IV, and V. Of the 51 samples, there were 16 fish with TKG II, which was the highest number in the sample. This suggests that most of the fish in the sample were at stage II of gonadal maturity. The second most abundant were fish

with TKG III and V, with 12 and 11 individuals, respectively. Meanwhile, there were seven fish in TKG I and five in TKG IV.

The degree of gonadal maturity is an important indicator of the reproductive cycle of fish and the overall health of the population. Understanding and monitoring gonadal maturity levels in fish populations can provide valuable information for sustainable fisheries management (Arif Habib Fasya &; Mufidah F, 2022; Sari, 2021).

For example, if many fish in a population have not reached the gonadal maturity level that allows them to breed, this could be a sign that the fish population may be harvested too early or too often, which could potentially threaten the long-term viability of the fish population.

In addition, changes in the distribution of gonadal maturity levels over time or between different locations may reflect changes in environmental conditions or fishery stresses, which can also affect the health and sustainability of fish populations.

Weight Length Relationship

The regression equation y = 0.76x - 66.15, and an R^2 value of 0.78 show a fairly strong relationship between the length and weight of the fish.

In the regression equation, 0.76 is the regression coefficient that describes how the weight of the fish changes with changes in the length of the fish. Specifically, for every 1 cm increase in fish length, the weight of the fish is expected to increase by approximately 0.76 gram. The value -66.15 is a constant and is the expected value of the weight of the fish when the length of the fish is 0. However, in a practical context, this value of 0 does not always have a meaningful interpretation, because fish with a length of 0 are unrealistic.

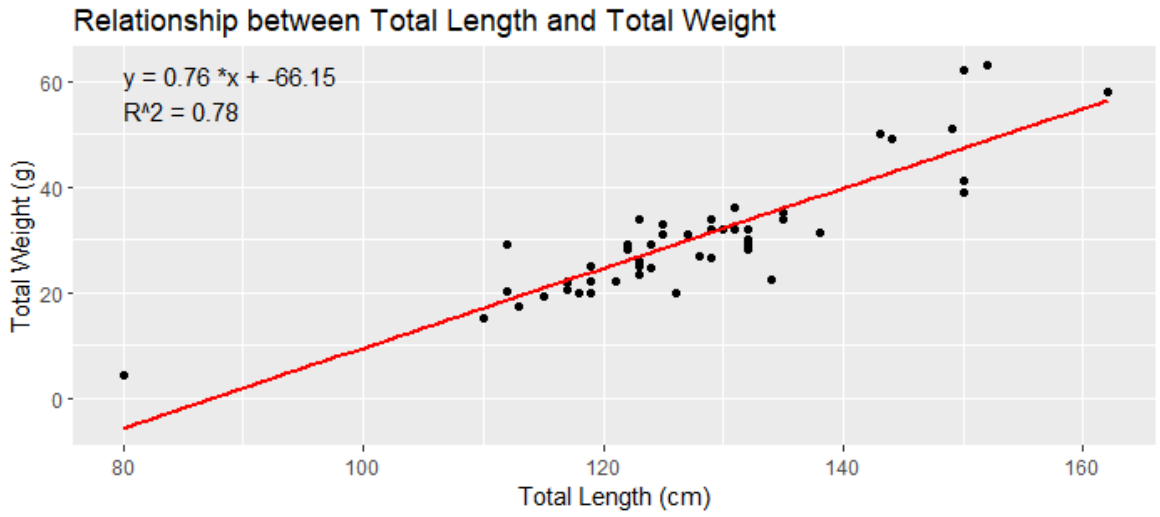

Figure 3. The Relationship of Length and Weight of *Puntius bulu*

An R^2 value of 0.78 indicates that approximately 78% of the variability in fish weight can be explained by variability in fish length. In other words, fish length is a good predictor of fish weight, and most of the variations in fish weight can be explained by variations in fish length. However, there was still a 22% variation in fish weight that was not explained by this model and may be due to other factors not included in this model.

In the context of fishery management, knowledge of the length of the weight relationship is essential. This information can be used to determine the optimal harvest size, assess fish stocks, monitor the health of fish populations, and understand the life cycle of fish (Efendiansyah, 2018; Nurhayati et al., 2016; Swarto et al., 2018). For example, if a fish grows rapidly and reaches a significant weight at a certain length, the harvest size can be set at that length to maximize yield without harming the fish population.

Cluster Analysis

From this graph, we can see that there are two distinct clusters in the data, represented by two different colors. This means that based on the combination of variables we have (total length, raw length, total weight, total gonad weight, sex, and gonad maturity level), there are two different groups of fish in the sample.

The results of the cluster analysis in this study provide valuable insights into the population structure of the Subhan fish (*Puntius bulu*). By grouping fish based on various variables, such as total length, raw length,

total weight, total gonad weight, sex, and gonad maturity level, this study succeeded in identifying two significantly different fish groups or clusters.

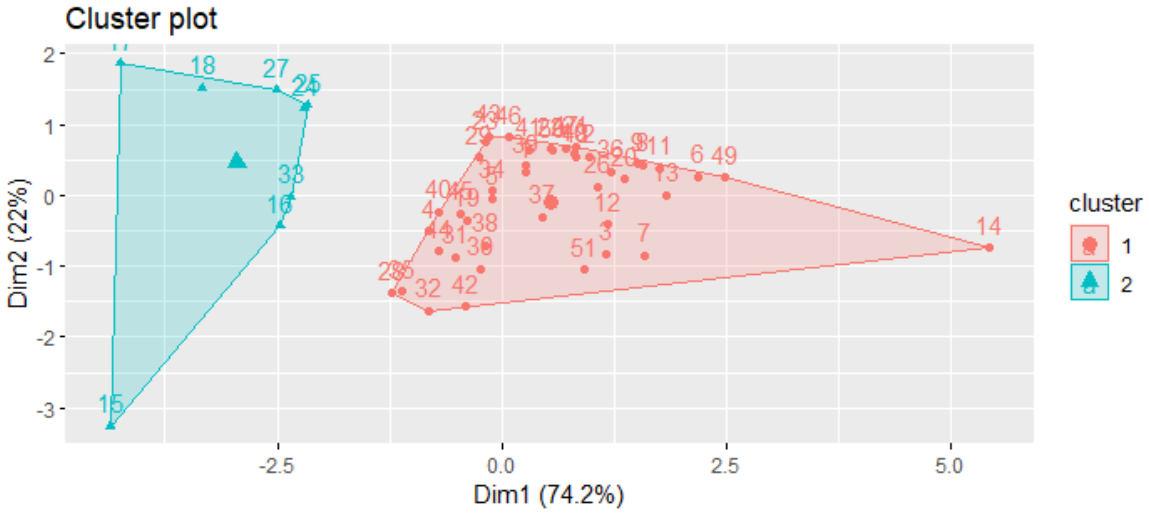

Figure 4. Cluster Analysis

From this graph, we can see that there are two distinct clusters in the data, represented by two different colors. This means that based on the combination of variables we have (total length, raw length, total weight, total gonad weight, sex, and gonad maturity level), there are two different groups of fish in the sample.

The results of the cluster analysis in this study provide valuable insights into the population structure of the Subhan fish (*Puntius bulu*). By grouping fish based on various variables, such as total length, raw length, total weight, total weight of gonads, sex, and degree of gonad maturity, this study succeeded in identifying two significantly different groups or clusters of fish.

The first cluster consisted mainly of larger and heavier fish, with heavier gonads. The majority of fish in this cluster were female, and most had IV or V gonadal maturity. This suggests that the fish in this cluster are most likely in the later stages of their reproductive cycle, which may reflect older age or favorable environmental conditions for growth and development. The fact that this cluster consists mainly of females may also indicate that females tend to grow larger and heavier than males, a phenomenon that is common in many fish species.

The second cluster, on the other hand, consisted of smaller and lighter fish with lighter gonads. The cluster had more male fish than female fish, and most had I, II, or III gonadal maturity levels. This suggests that fish in this cluster are likely in the early to mid-stages of their reproductive cycle, which may reflect a younger age or less favorable environmental conditions for growth and development. The fact that these clusters had a higher proportion of male fish may also reflect differences in behavior or life strategies between males and females.

Knowledge of the existence of different fish clusters can be used to develop different fishing strategies or design specific conservation measures. In addition, these results may also provide insight into the biology and ecology of the Subhan fish, which could help in further research on this species.

4. Conclusion

This study successfully explored the relationship between the length and weight of the Subhan fish (*Puntius bulu*) and identified cluster structures in fish populations based on various variables. The results showed a strong relationship between fish length and weight, reflecting growth patterns common to many fish species. In addition, the study revealed the presence of two distinct groups or clusters of fish in the population, which may reflect differences in life cycle stages, environmental conditions, or life strategies. Suggestions for future research development, to go deeper in understanding the factors that influence group formation in Subhan (Puntius bulu) fish populations, such as considering environmental factors, diet, and other biological parameters. In addition, research could involve further analysis of population data over time to track changes in group structure and the relationship between fish length and weight in line with environmental dynamics. Furthermore, collaboration with researchers in marine science and fisheries biology could enrich knowledge

on the potential implications of more detailed fisheries management and conservation. Finally, using advanced technologies such as satellite-based monitoring or the use of sophisticated mathematical models can help better understand the growth patterns and behavior of Subhan fish populations to support more effective fisheries management policies.

References

Arif Habib Fasya, & Mufidah F. (2022). Hubungan Panjang dan Berat terhadap Fekunditas Ikan Cupang (Betta sp.). *Journal of Aquaculture Science*, *7*(2). https://doi.org/10.31093/joas.v7i2.257

Branenda, W. P., Zulkarnain, Muninggar, R., Purwangka, F., & Apriliani, I. M. (2020). POLA MUSIM PENANGKAPAN IKAN LAYUR (Trichiurus spp) DI PERAIRAN TELUK PALABUHANRATU, SUKABUMI, JAWA BARAT. *ALBACORE Jurnal Penelitian Perikanan Laut*, *3*(3). https://doi.org/10.29244/core.3.3.297-310

Dulčić, J., & Kraljević, M. (1996). Weight-length relationships for 40 fish species in the eastern Adriatic (Croatian waters). *Fisheries Research*, *28*(3). https://doi.org/10.1016/0165-7836(96)00513-9

Efendiansyah, E. (2018). HUBUNGAN PANJANG DAN BERAT IKAN KEPERAS (Cyclocheilichtyhys apogon) DISUNGAI TELANG DESA BAKAM KABUPATEN BANGKA. *Akuatik: Jurnal Sumberdaya Perairan*, *12*(1). https://doi.org/10.33019/akuatik.v12i1.685

Elvince, R., & Aunurafik, A. (2020). Studi Pertumbuhan dan Biologi Reproduksi Ikan Tambayuk (Puntius lineatus) di Danau Hanjalutung, Kota Palangka Raya. *Jurnal Perikanan Universitas Gadjah Mada*, *22*(2). https://doi.org/10.22146/jfs.54001

Hasan, U., & Afriani, D. T. (2021). HUBUNGAN PANJANG BERAT DAN FAKTOR KONDISI IKAN SEMBILANG (Plotosus canius) DI SUNGAI BELAWAN. *Jurnal Aquaculture Indonesia*, *1*(1). https://doi.org/10.46576/jai.v1i1.1388

Japning, J. R. R., & Esa, Y. B. (2005). Restriction Fragment Length Polymorphisms (RFLPs) analysis of several freshwater fishes of Malaysia. *BULLETIN OF THE GENETICS SOCIETY OF MALAYSIA*, *11*(1).

Karel, M., Hilyana, S., & Lestari, D. P. (2020). PENGARUH PENAMBAHAN PROBIOTIK EM4 (Effective Microorganism) DENGAN DOSIS YANG BERBEDA PADA PAKAN TERHADAP HUBUNGAN PANJANG DAN BERAT IKAN MAS (Cyprinus carpio). *Jurnal Perikanan Unram*, *9*(2). https://doi.org/10.29303/jp.v9i2.148

Kuriakose, S. (2017). Estimation of length weight relationship in fishes. *Course Manual Summer School on Advanced Methods for Fish Stock Assessment and Fisheries Management. Lecture Note Series*, *L*.

Lim, L. H. S., & Furtado, J. I. (1986). Sixteen new species of Dactylogyrus from the genus Puntius Hamilton (Cyprinidae). In *Folia Parasitologica (Praha)* (Vol. 33).

Marasabessy, F. (2020). Hubungan Panjang Berat dan Faktor Kondisi Ikan Kembung Laki-Laki (Rastrelliger Kanagurta) di Sekitar Pesisir Timur Perairan Biak. *Barakuda 45: Jurnal Ilmu Perikanan Dan Kelautan*, *2*(1). https://doi.org/10.47685/barakuda45.v2i1.56

Mohamad Radhi, A., Nurul Fazlinda, M.-F., Amal, M. N. A., & Rohasliney, H. (2018). A review of length-weight relationships of freshwater fishes in Malaysia. *Transylvanian Review of Systematical and Ecological Research*, *20*(1). https://doi.org/10.1515/trser-2018-0005

Musingi, B., Kitaka, N., Ogondo, G., Muasya, T., Mahianyu, L., & Musingi, D. (2020). Evaluation of modelling in fish length-weight relationships: The current trends. *International Journal of Fisheries and Aquatic Studies*, *8*(5). https://doi.org/10.22271/fish.2020.v8.i5d.2335

Nasution, S. Y., & Machrizal, R. (2021). Faktor Kondisi dan Hubungan Panjang Berat Ikan Duri (Hexanematichthys sagor). *BIOEDUSAINS:Jurnal Pendidikan Biologi Dan Sains*, *4*(2). https://doi.org/10.31539/bioedusains.v4i2.2622

Nurhayati, N., Fauziyah, F., & Bernas, S. M. (2016). Hubungan Panjang-Berat dan Pola Pertumbuhan Ikan di Muara Sungai Musi Kabupaten Banyuasin Sumatera Selatan. *Maspari Journal*, *8*(2).

Olentino, D., Lubich, C. C. F., Rocha, M. D. P., Santos, J. H. N., Gomes, T., Beltrão, H., Silva, J. F., & Yamamoto, K. C. (2023). Length-weight relationships of fish from sandy beaches. *Brazilian Journal of Biology*, *83*. https://doi.org/10.1590/1519-6984.250003

Puspita, L., Padilla, N., Agustina, F., & Dikrurahman, D. (2021). Hubungan Panjang-Berat dan Pola Pertumbuhan Ikan Bawal Emas (Trachinotus sp.), Bawal Bintang (Trachinotus blochii, Lacepede), dan Bawal Hybrid di Balai Perikanan Budidaya Laut Batam. *SIMBIOSA*, *10*(2). https://doi.org/10.33373/sim-bio.v10i2.3506

Ramadhani, A., Muchlisin, Z. A., Sarong, M. A., & Batubara, A. S. (2017). Hubungan panjang berat dan faktor kondisi ikan kerapu Famili Serranidae yang tertangkap di Perairan Pulo Aceh Kabupaten Aceh Besar, Provinsi Aceh. *Depik*, *6*(2). https://doi.org/10.13170/depik.6.2.7017

Risti, N. M., Dewiyanti, I., & Nurfadillah. (2019). HUBUNGAN PANJANG-BERAT DAN KEBIASAAN MAKAN IKAN TONGKOL ABU-ABU (THUNNUS TONGGOL) DI PERAIRAN KABUPATEN ACEH BARAT DAYA. *Jurnal Ilmiah Mahasiswa Kelautan Dan Perikanan Unsyiah*, *4*(03).

Rojas, P., Pardo, R., & Vila, I. (2021). Length-weight relationships native fish of Southern Altiplano: Lauca National Park, Chile. *Journal of Freshwater Ecology*, *36*(1). https://doi.org/10.1080/02705060.2021.1971782

Santos, M. N., Gaspar, M. B., Vasconcelos, P., & Monteiro, C. C. (2002). Weight-length relationships for 50 selected fish species of the Algarve coast (southern Portugal). *Fisheries Research*, *59*(1–2). https://doi.org/10.1016/S0165-7836(01)00401-5

Sari, W. K. (2021). HUBUNGAN PANJANG BERAT DAN TINGKAT EKSPLOITASI. *JFMR-Journal of Fisheries and Marine Research*, *5*(1). https://doi.org/10.21776/ub.jfmr.2021.005.01.21

Sinaga, I., & Afriani, A. (2020). Hubungan Panjang dan Berat Ikan Kembung Lelaki (Rastrelliger kanagurta) Hasil Tangkapan Gill Net di Sibolga. *Jurnal Penelitian Terapan Perikanan Dan Kelautan*, *3*(2).

Swarto, M. D. H., Haeruddin, H., & Rudiyanti, S. (2018). HUBUNGAN PANJANG DAN BERAT IKAN NILA (Oreochromis niloticus) DALAM MEDIA PEMBESARAN DENGAN PENAMBAHAN ENZIM EZ-PLUS(SKALA LABORATORIUM). *Management of Aquatic Resources Journal (MAQUARES)*, *7*(1). https://doi.org/10.14710/marj.v7i1.22535