Himalayan Journal of Science and Technology, Vol.7 (2023) 126-131

Himalayan Journal of Science and Technology

Original Article

doi: FOR PEER REVIEW

Length-Weight Relationship of Fishes in Some Rivers of Morang, Nepal

[a]*Sharada Shrestha**, [a]*Ganesh Tamang*, [a]*Jash Hang Limbu and* [a]*Dipak Rajbanshi*

[a]Department of Biology, Central Campus of Technology, Tribhuvan University, Nepal
*Corresponding email: shresthasharada23gmail.com

Abstract

The length-weight relationship is a crucial aspect of fishery assessments, providing valuable biological information. The length-weight relationship is expressed by the equation $W = aL^b$, where W represents the total weight of the fish and L denotes the standard length. The LWR equation was transformed into a linear form using logarithmic transformation: LogW = a + bLogL. The biometric data obtained from this study includes information on species, sample numbers (N), standard length range, total weight range, and the length-weight relationship constants (a and b) for each species. In this study, we estimated the length-weight relationship of 16 freshwater fish species from some rivers of Morang district, Eastern Nepal. A total of 1,600 fish specimens, representing 16 different species from 5 families were studied from September 2022 to February 2023. The fishes were captured from the river and preserved in 20% formalin for subsequent biometric measurements in the laboratory. Biometric measurements were taken as follows: for each fish, length measurements were listed as standard length or fork length (SL in cm) from mouth to where the caudal fin is lobate. Length measurements were taken with a regular ruler validated against a Vernier Calliper, with an accuracy of 0.1 cm. Weight measurements were obtained using an electronic digital balance with a precision of 0.01 g. While listing weight, a fish consistency was maintained concerning the degree of wetness of the body to ensure accuracy. Among the species listed in the Morang district, *Puntius terio* has the smallest range of standard length (2.7 cm - 7.4 cm) and total weight (1.07 g - 7.06 g) while *Garra gotyla gotyla* has the largest range of standard length (4.3 cm - 18.6 cm) and total weight (4.5 g - 15.6 g). These variations indicate the natural size differences among the species. The analysis of the length-weight relationships revealed that all the studied fish species exhibited a negative allometric growth pattern. This means that as the length of the fish increases, its weight increases at a slower rate. The findings of this study contribute to our understanding of the growth patterns of freshwater fish species in the study area.

Article Info

Article history:

Received date:30 September 2023
Accepted date: 13 December 2023

Keywords:
Measurement,
Isometric,
Allometric,
Relationship constant

1. Introduction

The Length-Weight Relationship (LWR) is a valuable tool that allows for the estimation of fish weight based on length measurements, which is useful in yield assessments. It is also originally used to provide information on the condition of fish and may help determine whether somatic growth is isometric (b=3) or allometric (negative allometric: b<3 or positive allometric: b>3) (Sea, 2021). Isometric growth indicates that the body shape remains constant as the fish grows, while negative allometric growth suggests a slender body with increasing weight, and positive allometric growth indicates a relatively stouter or deeper-bodied fish as it increases in length. (Dan-kishiya, 2013). The regression analysis demonstrates high significance, indicating that the body weight of these fish species can be accurately estimated from their standard lengths (Zuchi et al., 2020). It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Tesch, 1978). The relationship is generally expressed by the equation: $W=aL^b$. LWRs are expressed in a formula, which allows the estimation

of the fish weight (W) using a particular length (L), and can be applied to study on gonadal development, feeding rate and maturity condition (Jisr et al., 2018).

Overall, this study provides insights into the variations in condition factors of fishes, growth pattern, and length-weight relationship of 16 fish species *(Acanthocobotis botia, Aspidoroa jaya, Aspidopria morar, Barillus barilli, Botia lohachata,Danio davario, Garra annandalei, Garra gotyla gotyla, Glossogobius giurius, , Mystus tangera, Puntius gonionotus, Puntius terio, Puntius sophore, Puntius ticto, Solmostoma acinaces Somileptes gongota)* of 5 families (Bagridae, Balitoridae Botidae, Cyprinidae, Gobiidae) of Morang district, Eastern Nepal. Length and weight measurements can give information on the stock composition, life span, mortality, growth and production (Stergiou M. , 2000). Despite the simplicity, it provides highly useful information for fisheries management and can be used in different applications like the estimation of biomass from length data or comparisons between growth patterns and morphologic differentiation of the same species from different populations (Zuchi et al., 2020). Weight-Length relationship of 16 fish species of Nepal haven't recorded so far. The results obtained from this study will be useful to ichthyologists. By delving into the intricacies of these 16 fish species, this study aims to contribute to our knowledge of aquatic ecosystems, evolution, and conservation efforts.

2. Materials and Method

2.1 Study Area

Keshaliya, Singhiya and Lohandra rivers are perennial rivers of Morang district, eastern Nepal having latitude and longitude of 26.60707873430 and 87.41554581730, 26.913^0 N and 87.157^0 E, 26.66254 and 87.40598 respectively. There are many factories and industries near the very rivers where industrial effluents, drainage from the city and wastes coming from disposed directly or indirectly into the river causing adverse effects on the aquatic flora and fauna due to which, the rivers exhibit reduced fish diversity. However, some predatory fishes have adapted to the conditions of the polluted river. Efforts to address the pollution and restore the health of these river are important for the conservation of fish diversity and the overall well-being of the aquatic ecosystem in the area.

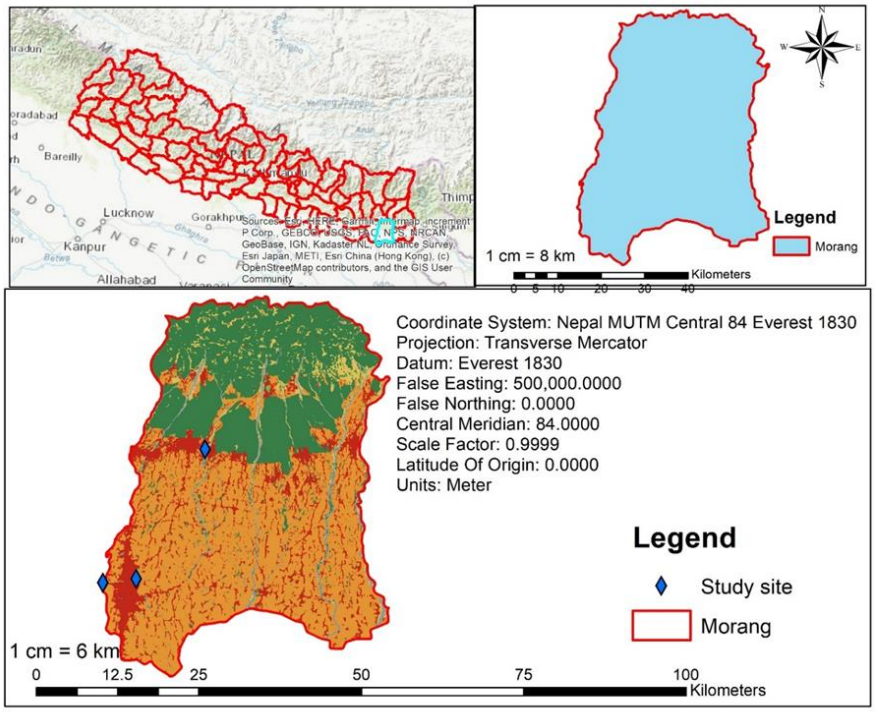

Figure. 1: Map of the study area

2.2 Methods

To estimate the length-weight relationship of 16 freshwater fish species,16 different fish species (100 each, total 1,600) were caught randomly using three cast nets of various sizes, one mesh size of 0.5 cm, a diameter of 5 m and a weight of 2 kg, and another with a mesh size of 2 cm, a diameter of 5 cm, and a weight of 4kg, another with a diameter of 4 cm, a length of 7 meters, and weight of 7 kg were used. Sample collection was done from September 2022 to February 2023 (twice a month) from natural habitat (river). Fish samples were also counted and identified up to their lowest possible taxon using the identification keys and checklist of 16 species which belonged to 5 families. They were collected and freshly preserved in 20% Formalin and in laboratory, was intact for direct biometric measurements. Biometric measurements of each fish were taken as follows: Length measurements were recorded as standard length or fork length (SL in cm) from mouth to where the caudal fin is lobate. They were measured to the nearest 0.1 cm by using a regular ruler validated against a Vernier calliper. Weight was measured using a digital balance with an accuracy of 0.01 g. While recording the weight of a fish, consistency was maintained concerning the degree of wetness of the body for accuracy.

3. RESULT AND DISCUSSION

The species listed include 16 fish species belonging to 5 different families (Cyprinidae, Gobiidae, Bagridae, Botidae, Balitoridae). The species studied included *Acanthocobotis botia, Aspidoroa jaya, Aspidopria morar, Barillus barilli, Botia lohachata, Danio davario, Garra annandalei, Garra gotyla gotyla, Glossogobius giurius, , Mystus tangera, Puntius gonionotus, Puntius terio, Puntius sophore, Puntius ticto, Solmostoma acinaces and Somileptes gongota.* All the species exhibit a negative allometric growth pattern. The somatic growth is isometric if (b=3) or allometric (negative allometric: b<3 or positive allometric: b>3). The “b” value (allometric coefficient) of *Puntius sophore* is 1.1686, *Garra Annandale* is 0.7874, *Barillus barilia* is 1.0893, , *Puntius terio* is 0.3035, *Puntius gonionotus* is 1.6274, *Garra gotyla gotyla* is 0.6656, *Danio davanio* is 1.3616, *Puntius ticto* is 2.058, *Acanthocobotis botia* is 0.9649, *Botia lohachata* is 0.8763, *Glossogobius giurius* is 0.8994, *Mystus tangera* is 1.0103, *Somileptes gongota* is 0.8999, *Solmostoma acinaces* is 1.1425, *Aspidoroa jaya* is 0.7796 and *Aspidora morar* is 1.0572.Since all the fish species had the b<3, they are recorded to have negative allometric growth. Negative allometric growth means that as the length of the fish increases, its weight increases at a slower rate. In the broad sense, these species tend to become relatively slimmer as they grow longer. The coefficient 'a' represents the intercept, while 'b' represents the slope of the relationship. Among the species listed, *Puntius terio* has the smallest range of standard length (2.7 - 7.4 cm) and total weight (1.07 - 7.06 g). On the other hand, *Garra gotyla gotyla* has the largest range of standard length (4.3 cm- 18.6 cm) and total weight (4.5 - 15.6 g). These variations indicate the natural size differences among the species.

It is crucial to note that the growth patterns and length-weight relationships observed in this study may be affected by various factors, including genetics, diet, environmental conditions, and life history traits specific to each of the species. It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Tesch, 1978) . Additionally, the sample size (N) of 100 individuals for each species provides a strong representation of the populations under study. Understanding the somatic growth patterns and length-weight relationships of fish species are important for fisheries management, conservation efforts, and understanding the ecological dynamics of aquatic ecosystems. This information can aid in assessing population health, determining optimal harvesting practices, and evaluating the overall productivity and sustainability of fish populations. The knowledge on LWRs for most tropical and sub-tropical fish species is still scarce (Baitha et al., 2018). This study also aids as an indicator of the physiological state of the fish and provides information when comparing two or more populations living in a certain feeding density, climate, habitat and other conditions. As a whole, the data presented in the table contribute valuable insights into the somatic growth patterns and length-weight relationships of the studied fish species, highlighting their diversity and providing a foundation for further research and conservation efforts.

Table 1: Descriptive statistics and estimated length-weight relationship parameters for sixteen freshwater fish species collected during September 2022 to February 2023 from some rivers of Morang district, Nepal.

Species	N	Standard Length (cm)		Total Weight(g)		Length Weight relationship constants			Growth Pattern
		Min	Max	Min	Max	a	b	R^2	
Puntius sophore	100	3.3	9.9	1.01	6.5	0.404	1.1686	0.2554	Negative allometric
Garra annandalei	100	4.2	14.9	4.5	13.3	1.4899	0.7874	0.7695	Negative allometric
Barillus barilli	100	4.7	12.5	1.2	7.4	0.4649	1.0893	0.4033	Negative allometric
Puntius terio	100	2.7	7.4	1.07	7.06	0.424	1.1729	0.3035	Negative allometric
Puntius gonionotus	100	3.3	7.2	1.01	4.9	0.1781	1.6274	0.5884	Negative allometric
Garra gotyla gotyla	100	4.3	18.6	4.5	15.6	1.8881	0.6656	0.6237	Negative allometric
Danio davanio	100	3.6	10.3	1.01	6.5	0.2527	1.3616	0.5143	Negative allometric
Puntius ticto	100	2.9	6.2	1.07	4.1	0.1057	2.058	0.5575	Negative allometric
Acanthocobotis botia	100	4.6	12.2	4.47	11.43	1.0111	0.9649	0.8963	Negative allometric
Botia lohachata	100	5.3	13.7	4.38	13.2	1.1983	0.8763	0.7316	Negative allometric
Glossogobius giurius	100	5.3	20.3	4.92	29.53	2.1622	0.8994	0.4133	Negative allometric
Mystus tangera	100	4.8	24.5	2.72	21.49	0.9814	1.0103	0.9841	Negative allometric
Aspidoroa jaya	100	6.3	14.8	4.41	11.02	1.2205	0.7796	0.7036	Negative allometric
Aspidora morar	100	5.8	18.5	2.95	20.82	0.55	1.0572	0.6724	Negative allometric
Somileptes gongota	100	7.4	15.8	7.05	22.47	1.3786	0.8999	0.3601	Negative allometric
Solmostoma acinaces	100	4.8	14.6	2.3	8.93	0.3859	1.1425	0.8515	Negative allometric

3.1 *Graphical Representation:*

Here are the graphical representation of of the *Puntius terio*, the smallest range of standard length (2.7 - 7.4 cm) and total weight (1.07 - 7.06 g and *Garra gotyla gotyla*, the largest range of standard length (4.3cm - 18.6 cm) and total weight (4.5 - 15.6 g) among 16 species recorded. The fish species having the lowest and highest b-value, *Garra gotyla gotyla* with 0.6656 and *Puntius ticto* with 2.058 respectively are also shown here.

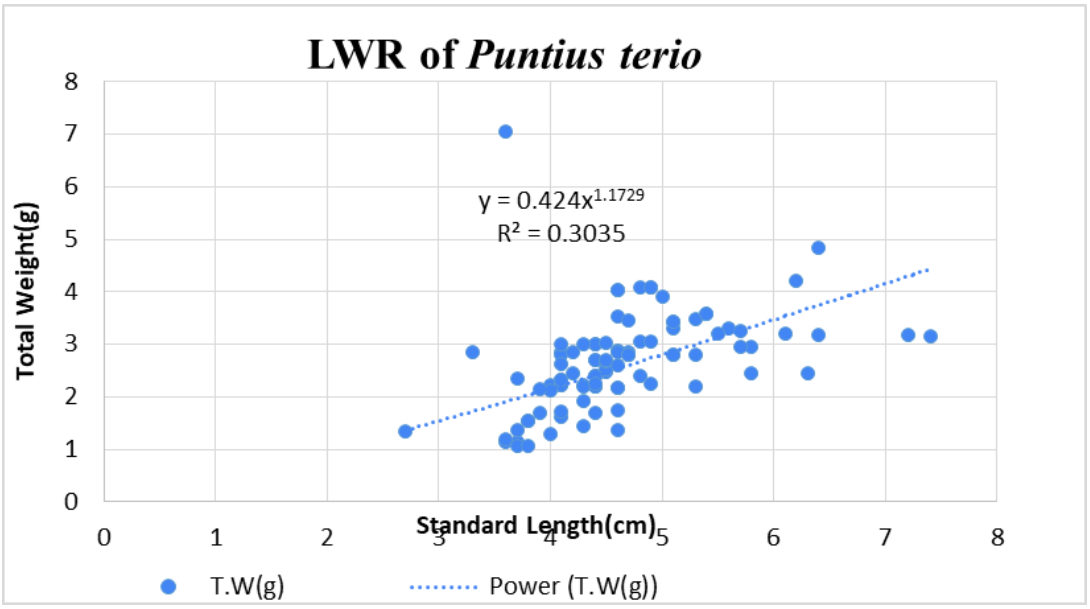

Figure.2: LWR of *Puntius terio*

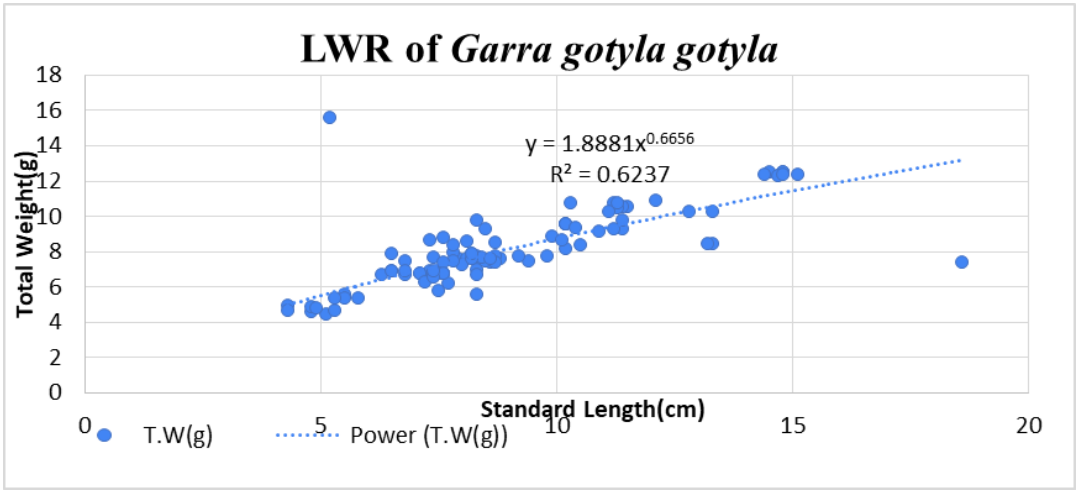

Figure.3: LWR of *Garra gotyla gotyla*

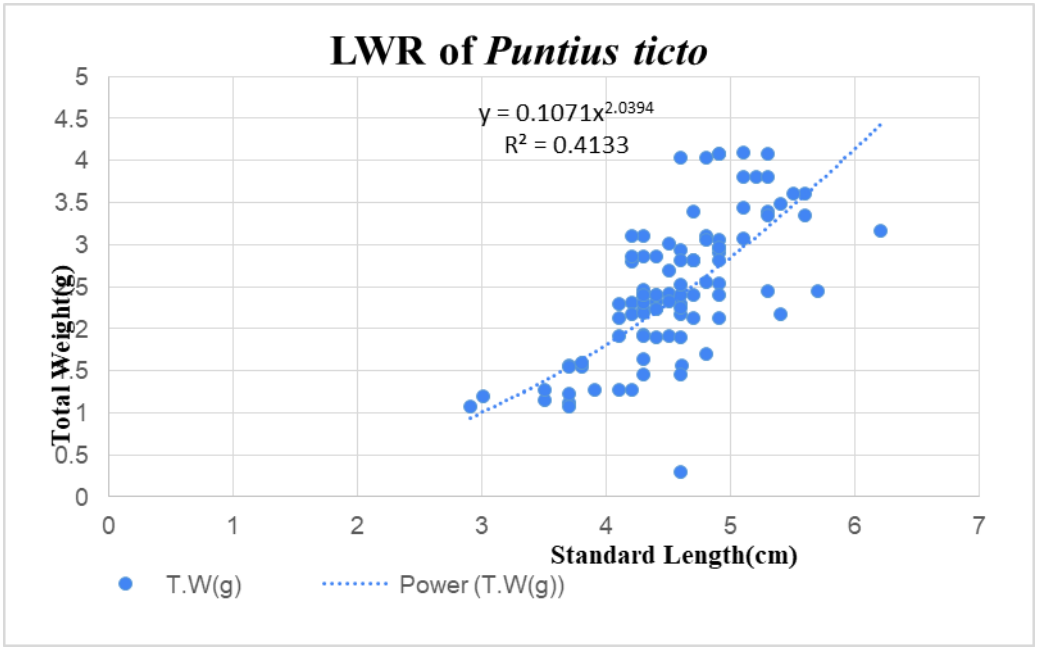

Figure 4: LWR of *Puntius ticto*

.

4. Conclusion

In conclusion, the study conducted in the Keshaliya, Singhiya, and Lohandra rivers in, Morang Nepal aimed to estimate the length-weight relationship (LWR) of 16 freshwater fish species. The biometric measurements of each fish species were recorded, and the LWR was estimated using the equation $W = aL^b$, where W represents the weight of the fish (g), L represents the standard length of the fish (cm), 'a' is the regression constant, and 'b' is the allometric coefficient. The analysis of the length-weight relationships revealed that all the studied fish species exhibited a negative allometric growth pattern. This means that as the length of the fish increases, its weight increases at a slower rate. In other words, these species tend to become relatively slimmer as they grow longer. The coefficient 'a' represents the intercept, while 'b' represents the slope of the relationship. The findings of this study contribute to our understanding of the growth patterns of freshwater fish species in the study area. The negative allometric growth observed in these species suggests that their body shape changes as they grow, becoming relatively slimmer compared to their length. Such information is valuable for yield assessments and understanding the condition of fish populations. Future research can build upon these findings to further explore the factors influencing the growth patterns of these fish species and their implications for fisheries management and conservation efforts.

Acknowledgments

The authors acknowledge and extend sincere thanks to Department of Biology, Central Campus of Technology, Dharan for facilitating the research.

Conflicts of Interest

The authors declare that there is no conflict of interest.

Funding

No Funding resource.

References

Baitha, R., Sinha, A., Koushlesh, S. K., Chanu, T. N., Kumari, K., Gogoi, P., Ramteke, M. H., Borah, S., & Das, B. K. (2018). Length-weight relationship of ten indigenous freshwater fish species from Gandak River, Bihar, India. *Journal of Applied Ichthyology*, *34*(1), 233–236. https://doi.org/10.1111/jai.13555

Dan-kishiya. (2013). Length-weight relationship and condition factor of five fish species from a tropical water supply reservoir in abuja, Nigeria. Length-weight relationship and condition factor of five fish species from a tropical water supply reservoir in. *American Journal of Research Communication Abuja, Nigeria. American Journal of Research Communication*, *1*(19), 175–187. www.usa-journals.com

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,. *The Egyptian Journal of Aquatic Research*, *44*(4), 299–305. https://doi.org/10.1016/j.ejar.2018.11.004

mindat.org. (2023 , May 5). *scientific classification of puntius terio using table*. Retrieved from mindat.org: https://www.mindat.org/taxon-2364088.html

Mineralogy,H.I.(2021,april16).*mindat.org*. Retrieved from mindat.org: https://www.mindat.org/taxon-2364088.html

Sea, M. (2021). *Length-Weight Relationship of 60 Fish Species From the Eastern*. *8*(July), 1–7. https://doi.org/10.3389/fmars.2021.625422

Stergiou, M. (2000). The selection of suitable indices for the measurement and analysis of fish condition. 171–182.

Zuchi, N., Röpke, C., Shibuya, A., Farago, T., Carmona, M., Zuanon, J., & Amadio, S. (2020). Length-weight relationship of fish species from Central Amazon floodplain. *Journal of Applied Ichthyology*, *36*(6), 837–841. https://doi.org/10.1111/jai.14082