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Biodiversity and Length-Weight Relationship of Rohu (*Labeo rohita*) and Silver Carp (*Hypophthalmichthys molitrix*) in the River Indus, Pakistan: A Healthcare Context

Original Article

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Abstract

The primary aims of this study are to assess the biodiversity and establish length-weight relationships for two economically important fish species, namely silver carp (*Hypophthalmichthys molitrix*) and Rohu (*Labeo rohita*), in the Dera Ismail Khan region of Pakistan. Throughout one year, a comprehensive sampling approach was employed to collect data on fish populations inhabiting the River Indus and its adjacent aquatic ecosystems. To get comprehensive data on the distribution and population size of the species, a combination of traditional fishing equipment, such as gill nets and cast nets, and non-intrusive methods of data collection was employed. The findings of this study indicate that the River Indus exhibits a notable level of biodiversity, with the silver carp and Rohu species emerging as prominent members of the fish community. The development of length-weight relationships for both species, utilizing a range of size classes, will prove valuable in monitoring their growth and assessing their overall well-being within the ecosystem. The comprehension of the fish diversity and population dynamics of Rohu and Silver Carp has significant importance in Dera Ismail Khan. Moreover, the study's findings about the relationships between length and weight can serve as a valuable resource for conservation and fisheries management efforts. This, in turn, can contribute to the promotion of sustainable resource utilization and the preservation of the invaluable aquatic ecosystem under consideration.

Keywords: Carp Fishes, Growth Patterns, Morphological Variation, River Indus, Water Quality Parameters.

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Introduction

Throughout history, fish have been widely recognized as a highly nutritious protein source that is easily digestible and possesses numerous therapeutic properties. It has been found to offer various health benefits, including the prevention and management of conditions such as heart disease, macular degeneration, and mental health disorders (Ray & Vashishth, 2024). Fish play a crucial role in providing sustenance to large populations in underdeveloped locations, serving as the primary and affordable source of animal protein (Baloch *et al*., 2023). It includes an adequate quantity of protein as necessary for the average individual. The current estimation is that around one billion individuals worldwide rely heavily on fish as their major source of animal protein. This intervention has both medical and economic benefits. There is a wide range of fish species that are rich in omega-3 fatty acids (A Abro *et al*., 2020). Furthermore, it has been proposed that aquatic biota, particularly the fauna consisting of various fish species, have significant relevance within the aquatic ecosystem. These organisms contribute to the environment in several ways, including their status, composition, and serving as a foundation for the implementation of sustainable management practices in aquatic systems. The term "fauna" is used to describe the variety of animal species that are influenced by their surrounding environment and other circumstances. Pakistan is seen as a very promising nation that exhibits a wide range of fauna, particularly in its freshwater fish specimens. These specimens are considered valuable for studying the many variables that influence the composition and organization of fish communities. The examination of the relationship between weight and length has demonstrated a significant connection in contemporary aquaculture methodologies, allowing for the conversion of length measurements into corresponding weight values and vice versa (Jamali, Mesri, & Khoshravesh, 2024).

The concept of "Biodiversity" encompasses the diverse array of life forms across various levels of biological organization, such as genetic diversity within populations, population diversity within species, species diversity within communities, community diversity within landscapes, landscape diversity within biomes, and biome diversity within the biosphere (Levin, Woodford, & Snow, 2019). The term "Biodiversity," derived from the phrase "biological diversity," is a relatively recent addition to the realm of conservation studies. The word "Biodiversity" gained prominence in the early 1980s, coinciding with the publication of influential works such as "Limits to Expansion." This literature explored the ramifications of unrestricted population and economic expansion on the environment, contributing to the heightened attention around the concept (Treml, 2025). The aforementioned term has been employed in several ways, with varying degrees of emphasis placed on ecological and genetic diversity, as well as species richness (Wootton, Curtsdotter, Bommarco, Roslin, & Jonsson, 2023). The word "Biodiversity" is often attributed to W.G. Rosen, who is recognized for its coinage in 1985 during his involvement in the organization of the "National Forum on Biodiversity," a significant event that took place in the United States later that same year. Biodiversity, seen as a type of "natural capital" that fosters ecosystem health, is a notion that is undergoing constant development. In recent times, it has been integrated within the framework of ecosystem services (Cantonati *et al*., 2020).

The river Indus sustains a diverse ecosystem, supporting the growth and proliferation of mangrove trees, several avian species, and a multitude of fish species. The delta includes marshes and mangroves, spanning a vast expanse of more than 225,000 hectares (equivalent to 556,000 acres). The delta in question receives assistance in its last phases of passage from the port city of Karachi and the Ran marches of Kutch (Ayodele, Adelodun, & Oluwagbohunmi, 2023). Fish surpass all other vertebrate groups in terms of species and diversity across various taxonomic levels. According to (Feiner *et al*., 2022). There are a total of 482 families comprising living species, which accounts for 24,618 out of the 48,170 identified vertebrates.

This represents almost half of all vertebrates. Only a small number of categories possess the highest species richness in terms of taxonomy. According to Nelson (1994), a total of 2662 species belonging to the Cypriniformes order, 2287 species belonging to the Siluriformes order, and 66 species belonging to the Salmoniformes order were named. However, in the specific context of India, a study has identified 930 freshwater species from 326 genera and 99 families. India is responsible for 11% of the global fish diversity, with a total of 2200 recognized species (Rana, Singh, Thapliyal, & Thapliyal, 2025).

The *Labeo rohita* is a species of freshwater potamodromous ray-finned fish that belongs to the carp family. The body has moderate elongation, displaying bilateral symmetry, with a dorsal shape that is more convex than its ventral profile. The cranium is devoid of dermal scales. The eyes of this organism are situated dorsolateral, rendering them not visible from the external surface of the skull. The nose, on the other hand, possesses a somewhat flattened structure and protrudes beyond the mouth without exhibiting a lateral lobe.

Figure 1

Biodiversity of Fishes in River Indus (Hawksworth DL. 1995)

The oral cavity exhibits inferior characteristics, characterized by the presence of large lips adorned with pronounced inner folds on each lip, which may be either foliate or undivided. The maxillary region exhibits a pair of diminutive whiskers that are positioned within lateral grooves. The dentition of the jaws is absent, including three sets of pharyngeal teeth, and the upper jaw does not extend to the lateral edges of the ocular region. The pectoral and pelvic fins are laterally positioned. Osteophytes are not present in the pectoral fins. The caudal fin has a high degree of branching. Typically, the lower lip is linked to the isthmus by a narrow or wide bridge. The placement of the dorsal fin is seen to be positioned equidistantly between the snout's apex and the caudal fin's base. The pre-dorsal scale count ranges from 12 to 16. The lateral line is complete, clearly discernible, and extends along the median line of the caudal peduncle. The number of transverse scale rows between the lateral line and base of the pelvic fins ranges from 6 to 6.5. The lateral line is composed of 40 to 44 scales. The nose lacks lateral lobes and is not truncated in shape. The coloration of this species has a blueish hue on the back, while the flanks and belly seem silvery (Nayak *et al.*, 2024).

The present research was conducted at two specific locations along the Indus River, namely Ghaffar tee and Prova. These sites are situated near the northern region of District Dera Ismail Khan.

Type I: Ghaffar Khan Tee,
Type II Prova at River Indus, Dera Ismail Khan.

Literature Review

A study was undertaken from May 2016 to September 2016, spanning one month, to investigate the dam-dwelling fish species *Labeo rohita* (Rohu), *Hypophthalmichthys molitrix* (Silver carp), and *Catla catla* (Catla) in Chambai. A total of 50 fish specimens were collected per species at the Chambai Dam District of Khyber Pakhtunkhwa. The mean lengths and weights of *Labeo rohita*, *Hypophthalmichthys molitrix*, and *Catla catla* were recorded as 30.48 cm and 160 g, 17.78 cm and 26 g, and 10.16 cm and 15 g, respectively. The weight-length relationship of *Labeo rohita, Hypophthalmichthys molitrix*, and *Catla catla* is considered to be of significant utility in the fields of fisheries research, fish biology, and fish ecology (Khan, Jawad, Khan, & Ankita, 2022). A sample of sixty-five *Labio rohita* individuals, with weights varying between 150 g and 5,000 g, was utilized to determine fecundity. The relationships between many variables, such as total length and fecundity, total weight and fecundity, ovarian weight and fecundity, total length and ovary weight, and total weight and ovary weight, have been established for the species. The parameters exhibited a statistically significant correlation. The estimation of the proportion of eggs retained in the ovary of the Rohu fish

during the process of spawning has been conducted. The investigation revealed that there was no discernible impact of fish size on both ovarian weight percentages and fecundity measures (Chelapurath Radhakrishnan, Kuttanelloor, & Balakrishna, 2020).

This research presents comprehensive insights into the length-weight relationships of *Labeo rohita* (Hamilton) sourced from the Ghaghara River in Uttar Pradesh. In the present investigation, a total of 107 specimens were collected and subjected to measurements of their length and weight. The purpose of this endeavor was to contribute to the effective management and enhancement of Rohu conservation efforts. In this study, a total of 107 specimens were examined, with their dimensions ranging from 25.2 to 56.13 cm TL (Total length) and weights ranging from 183.3 to 2409.78 grams. These specimens were used to evaluate the length-weight relationships (LWRs) and condition variables. The findings of our study indicate that L. rohita exhibited a negative allometric growth pattern (b3), wherein the rate of length development surpassed that of weight gain in the fish. The condition factor (K) has a value of 0.8601, while the correlation coefficient (r^2) has a value of 1.27. This work will provide valuable contributions to fishing research, stock assessment, conservation, and estimation (Bhanu, Prasad, & Choudhary, 2024). The key global factors that influence the distribution of fish species richness are the size of rivers, as measured by the surface area of the drainage basin and the mean annual river flow, as well as the availability of energy, specifically net primary productivity. The influence of local-scale features is determined by climatic factors, in conjunction with historical factors such as rates of speciation and spread (Tripathi, Gopesh, & Dwivedi, 2017). On a local level, the abundance of different species is impacted by several physical elements, including the diversity of habitats, the chemistry of water, the temperature, the flow patterns, and the shape of the channels. Additionally, biological factors such as competition between different species and predation also play a role in determining species richness. Hence, it is plausible that both small-scale and large-scale processes contribute to the observed patterns in local communities (Nazeer, Hashmi, & Malik, 2016).

Materials and Methods

Study Area

The Indus River traverses several regions, including Dera Ismail Khan, Pharpur, Bilot, Mandra, Naurang, Shorkot, Roda, and Prova, before ultimately merging with the Arabian Sea close to the port city of Karachi. The Indus Delta, ranking as the fifth-largest delta globally, is characterized by its significant river discharge, regular tidal patterns, and potentially the highest river wave energy of all delta's worldwide (Rehman, Khan, Gul, Rehman, & Asad, 2016).

Figure 2

Google Map of the River Indus in District Dera Ismail Khan

Data Collection

The data was obtained from the Indus River, situated near Dera Ismail Khan, through the utilization of two distinct methodologies.

Passive Technique

Passive fishing tactics refer to a variety of strategies employed for collecting fish without the need for active pursuit or chase. Conversely, these methodologies depend on the utilization of mechanisms such as traps, nets, or other apparatuses to ensnare fish as they navigate into or in close proximity to them. Passive fishing techniques are frequently employed in both commercial and recreational fishing endeavors, since they have demonstrated enhanced efficiency and reduced labor requirements when compared to active methodologies. The following are a few prevalent passive fishing techniques:

Active Method

Active fishing tactics encompass the deliberate and proactive pursuit and capture of fish using several techniques. Angling, a widely employed active technique, entails the utilization of a fishing rod, line, and hook to capture fish.

For the Identification of Fish Species

On-site identification and photographic documentation were conducted utilizing a 13-megapixel Huawei Nova 3i camera for the purpose of identifying and documenting large growing fish belonging to a significant taxonomic group. The process of identifying and confirming the species involved referring to taxonomic literature sources. Talwar and Jhingran (1991), Jayaram (1999), and Vishwanath *et al.* (2007, 2014).

Length-Weight Correlation

The application of Cube's law was utilized to analyze the weight and length of fish samples that were gathered, resulting in the establishment of a relationship between the length and weight of *Labeo rohita*. The measurement of the total length of each fish was taken from the anterior-most edge of the lower lip, also known as the tip of the snout, to the posterior-most edge of the caudal fin, with the nearest millimeter being recorded. The weight of the fish was measured with an accuracy of milligrams following the removal of moisture by blotting it with paper towels. Fish were excluded from the study if their caudal fin exhibited any form of injury. The logarithmic values for the measurements of length and weight were calculated using the Microsoft Excel 2007 software.

Statistical Analysis of Data

Length-weight relationship and Condition factors

The calculation of length-weight relationships was performed using the least square fitted approach on Log converted data, employing the function recommended by Le Cren. Equation $W= aL^b$ in the Excel computer program. In this study, we denote the total weight of fish as W, measured in grams. The length of the fish is represented by L, measured in centimeters. The constant condition factor is denoted by 'a', while the exponent 'b' signifies the kind of growth, whether isometric or allometric. The parameters and b were calculated by the use of linear regression on the transformed equation.

Equation 1 can be represented in linear form through the utilization of logarithms, as demonstrated below:

$$\text{Log } W = \text{Log } a + b \text{ Log } L$$

The values for the constants c and n were determined by empirical methods, utilizing the following formulae:

$$\mathbf{a} = \frac{\sum \mathbf{Logw}.\mathbf{2}(\sum \mathbf{logL}) - \sum \mathbf{LogL}.\sum(\mathbf{LogLxLogw})}{\mathbf{N}\sum \mathbf{Log})\mathbf{2} - (\sum \mathbf{LogL})\mathbf{2}}$$

$$\mathrm{n} = \frac{\Sigma \mathrm{LogW} - \mathrm{NLogC}}{\Sigma \mathrm{Log}l}$$

Length Frequency

The computer software package FiSAT II, a stock evaluation tool, was utilized to analyze length-frequency data to determine the parameters of growth, namely the g parameters.

Results and Findings

A total of 184 fish samples were taken from two distinct sites over a period of 6 months. Specifically, 94 samples were obtained from the Prova site, while 90 samples were gathered from the Ghaffar Khan Tee region in D. I. Khan. The distribution of these samples is illustrated in the accompanying figure. The observed length-weight data of *Labeo rohita* exhibited a range of 22.0 to 70.0 cm in terms of length, and a weight range of 200gm to 3500gm. Samples of *Labeo rohita* were obtained at Ghaffara Tee 15 from March to August, respectively. A total of 16 samples of *Labeo rohita* were gathered at the Prova site during March and April. Additionally, 18 samples were obtained in May, and 15 samples were taken in June, July, and August, respectively.

At Ghaffara Tee, the mean weight of *Labeo rohita* was found to be 1230.6 grams, with a standard error of 71.15. The cumulative mass amounted to 115,678 grams. The Ghaffara Tee exhibited a total length of 4102.5 cm, with an average length of 48.5 cm and a standard error of 1.13. At the Prova, the total weight recorded was 154,696 grams. The average weight observed was 1,718.84 grams, with a standard error of 84.78. The Prova exhibited a total length of 4327 cm, with an average length of 48.62 cm and a standard error of 1.11. At both locations along the River Indus, the combined weight of the samples was 270,374 grams. The average weight of the samples was calculated to be 1,469.42 grams, with a standard error of 57.88. The combined length observed at the two locations amounted to 8478.5 cm, with an average length of 46.07 cm and a standard error of 0.81. The relationship between length and weight can be determined by applying the cube law.

$$W=aL^{b}$$

W is the weight of the fish

The weight and length correlation coefficient were 0.92 at the river Indus.

Calculation of Sample Size

Le Cren proposed a logarithmic transformation for the given statement.

LOGW=Loga + blogl

First, we will find" a" value by formula

$$\mathbf{a} = \frac{\sum \mathbf{Logw}.\mathbf{2}(\sum \mathbf{logL}) - \sum \mathbf{LogL}.\sum(\mathbf{LogLxLogw})}{\mathbf{N}\sum \mathbf{Log})\mathbf{2} - (\sum \mathbf{LogL})\mathbf{2}}$$

Where N=184

By putting value in the formula, we get

a =7.21

By putting the above value in the following formula, we get.

$$\mathbf{b} = \frac{\sum \mathbf{Logw}) - (\mathbf{NLoga})}{\sum \mathbf{LogL}}$$

We got the b value of 1.46. Here b value is less than 3, so fish show algometric growth, so different parts of the body grow at different rates in *Labeo rohita*
The link between length and weight can be determined by applying the cube law.

$$W=aL^b$$

Where, W is the weight of the fish?

A considerable disparity in the weight of *Labeo rohita* was observed between the locations of Ghaffara Tee and Prova. The individuals had a greater weight at Prova in comparison to Ghaffara Tee. The weights of individual *Labeo rohita* specimens of equivalent length can exhibit variation due to multiple factors, such as the quantity of stomach contents, level of maturity, liver mass, and overall body condition. The study found that the impact of stomach contents on the weight of the fish was negligible. In numerous cases, the sharks exhibited the behavior of the eversion of their stomachs before undergoing the process of weighing.

Figure 3
Total Sampling

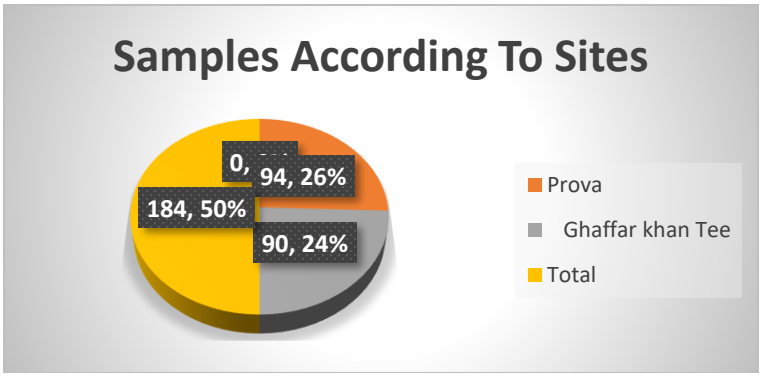


Table 1
Sample at Ghaffar Khan Tee

Month	Sample
March	15
April	15
May	15
June	15
July	15
August	15
Total	**90**

Figure 4
Ghaffar Khan Tee samples

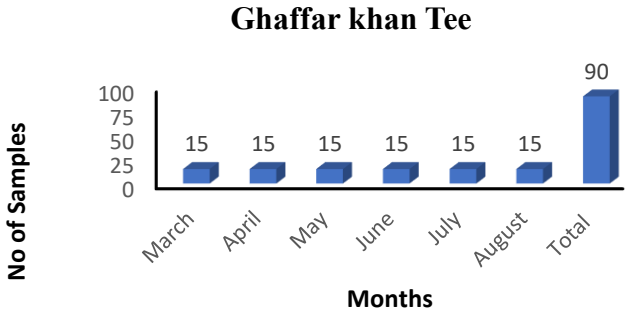


Table 2
Fish (Rohu) Sampling in March 2023

S. No	weight (gm)	Length (cm)
1	3400	65
2	2000	51
3	1090	43
4	2225	56
5	3500	68
6	2000	52
7	2200	55
8	1700	50
9	2000	54
10	1980	53
11	2150	55
12	3250	60
13	1900	47
14	2500	60
15	2370	58
Total	34265	827
Average	2284.333333	55.13333333
S.E	84.78	1.11

Table 2
Fish (Rohu) Sampling in April 2023

S. No	weight (gm)	Length (cm)
1	2350	57
2	2200	51
3	2150	49
4	2000	45
5	2200	52
6	3200	61
7	2100	44
8	2100	47
9	2800	55
10	2900	56
11	2100	50
12	3250	61
13	3000	59
14	2450	58
15	2400	57
Total	37200	802
Average	2480	53.46666667
S.E	84.78	1.11

Table 4
Sampling in May 2023

S. No	weight (gm)	Length (cm)
1	1800	44
2	2350	57
3	1900	51
4	2000	52
5	900	37
6	950	39
7	2060	56
8	2000	54
9	1000	43
10	1430	47
11	1950	53
12	930	38
13	1790	58
14	1800	54
15	2400	57
Total	25260	740
Average	1684	49.33333333
S.E	84.78	1.11

Table 5
Sampling in June 2023

S . No	weight (gm)	Length (cm)
1	1900	52
2	890	38
3	1780	55
4	1990	60
5	1950	61
6	1790	58
7	2500	57
8	2200	56
9	2300	60
10	2280	60
11	655	33.5
12	325	29
13	650	34.5
14	900	43
15	940	45
Total	23050	742
Average	1536.666667	49.46666667
S.E	84.78	1.11

Table 3
Fish (Rohu) Sampling in July 2023

S. No	weight (gm)	Length (cm)
1	880	43
2	1220	41
3	870	40
4	2225	56
5	1674	46
6	2000	54
7	1600	47
8	1980	53
9	1200	45
10	1150	41
11	2280	67
12	1700	52
13	2040	55
14	2320	68
15	2060	56
Total	25199	764
Average	1679.933333	50.93333333
S.E	84.78	1.11

Table 4
Fish (Rohu) Sampling in August 2023

S. No	weight (gm)	Length (cm)
1	2000	50
2	760	40
3	600	32
4	200	29
5	600	35
6	250	33
7	300	32
8	550	33
9	660	36
10	1100	41
11	550	27
12	500	25
13	1152	41
14	200	22
15	300	25
Total	9722	501
Average	648.1333333	33.4
S.E	84.78	1.11

Table 5
Diversity of Rohu (Lebeo Rohita) in length - weight in Ghaffar Khan tee

Month	Average weight	Average Length
March	2284.33	55.1333
April	2480	53.46667
May	1684	49.33333
June	1536.667	49.46667
July	1679.933	50.93333
August	648.1333	33.4

Figure 6
Diversity of Rohu in length - weight in Ghaffar Khan tee

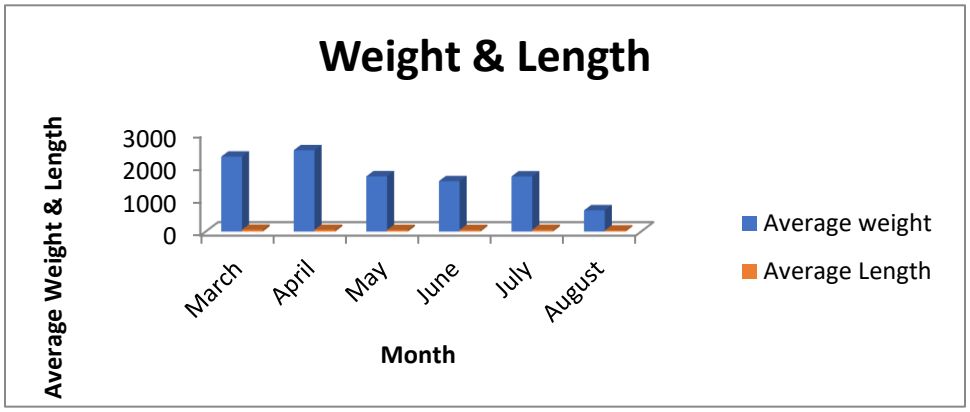


Table 6
Sample size at Prova site

Month	Sample
March	16
April	16
May	18
June	15
July	15
August	15
Total	94

Figure 7
Sampling of the Prova Site

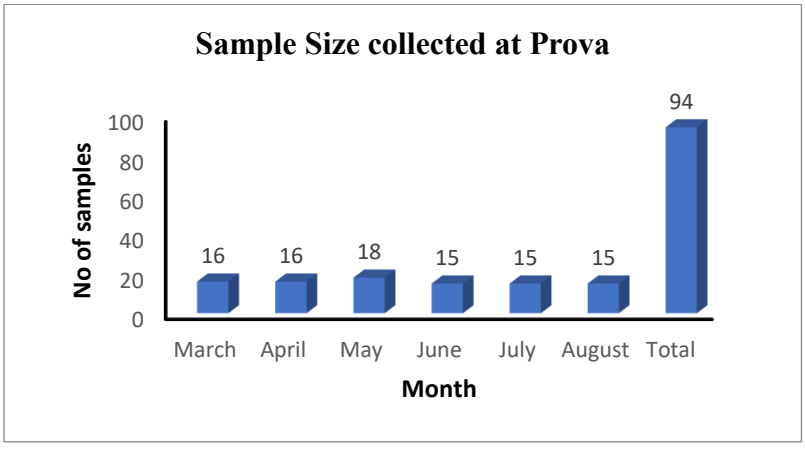


Table 7
Sampling in March 2023 at Prova

S. No	weight (gm)	Length (cm)
1	2100	58
2	500	22.5
3	550	26
4	1200	51
5	780	40
6	1020	44
7	500	30
8	750	40
9	3300	59
10	740	39
11	680	39
12	715	37
13	700	34
14	760	41
15	850	43
16	760	40
Total	15905	643.5
Average	994.0625	40.21875
S.E	71.15	1.15

Table 8
Sampling in April 2023 at Prova

S. No	weight (gm)	Length (cm)
1	2000	50
2	2060	56
3	2300	68
4	2030	55
5	1700	52
6	2280	67
7	1144	41
8	1200	45
9	1980	53
10	1600	47
11	2000	54
12	1675	46
13	2225	56
14	870	41.5
15	2500	57
16	2200	56
Total	29764	844.5
Average	1860.25	52.78125
S.E	71.15	1.15

Table 12
Sampling in May 2023 at Prova

S. No	weight (gm)	Length (cm)
1	2300	60
2	2280	60
3	655	33.5
4	325	29
5	650	34.5
6	900	43
7	940	45
8	880	43
9	1220	41
10	335	29.5
11	190	24.5
12	542	32
13	220	25.5
14	2240	58
15	1152	41
16	500	25
17	550	27
18	1100	41.5
Total	16979	693
Average	943.2777778	38.5
S.E	71.15	1.15

Table 13
Sampling in June 2023 at Prova

S. No	weight (gm)	Length (cm)
1	660	33
2	550	33
3	300	32
4	250	30
5	600	32
6	200	30.5
7	600	32
8	1800	52
9	1500	47
10	1750	51
11	1500	47
12	1700	51
13	1400	46
14	1050	40
15	1800	54
Total	15660	610.5
Average	1044	40.7
S.E	71.15	1.15

Table 14
Sampling in July 2023 at Prova

S. No	weight (gm)	Length (cm)
1	800	38
2	1090	42
3	510	34
4	1430	47
5	600	36
6	620	37
7	1200	44
8	1900	55
9	1750	54
10	1710	53
11	1900	52
12	890	38
13	1780	55
14	1990	60
15	1950	61
Total	20120	706
Average	1341.333333	47.06666667
S.E	71.15	1.15

Table 15
Sampling in April 2023 at Prova

S. No	weight (gm)	Length (cm)
1	1790	58
2	500	37
3	900	38
4	930	38
5	520	32
6	1700	51
7	2400	57
8	2250	60
9	550	25
10	590	26
11	600	36
12	900	38
13	1700	53
14	1920	56
Total	17250	605
Average	1232.142857	43.21428571
S.E	71.15	1.15

Table 16
Average Weight and length at Prova site

Month	Average weight	Average Length
March	994.0625	40.21875
April	1860.25	52.78125
May	943.2778	38.5
June	1044	40.7
July	1341.333	47.06667
August	1232.143	43.21429

Figure 8

Diversity of Length-Weight at Prova

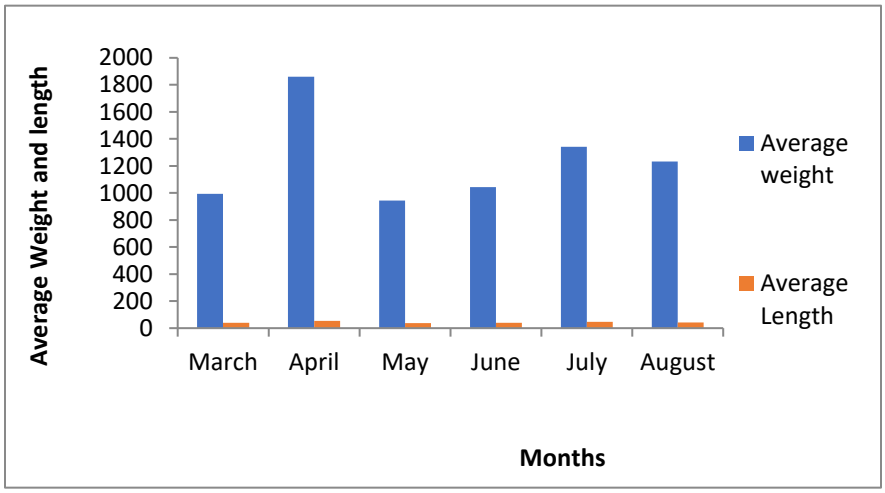


Table 17

Fish Diversity in weight at Two sites

Month	Average weight Ghaffar Tee	Average weight at Prova
March	2284.33	994.0625
April	2480	1860.25
May	1684	943.2778
June	1536.667	1044
July	1679.933	1341.333
August	648.1333	1232.143

Figure 9

Diversity of Weight at Prova and Ghaffar Khan Tee

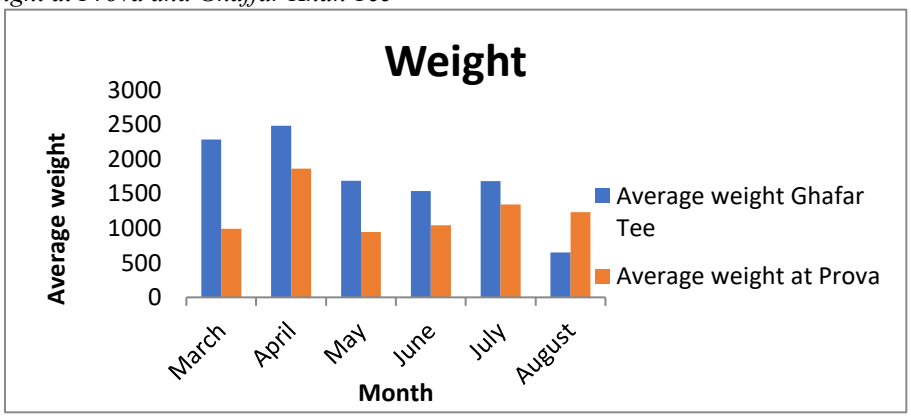
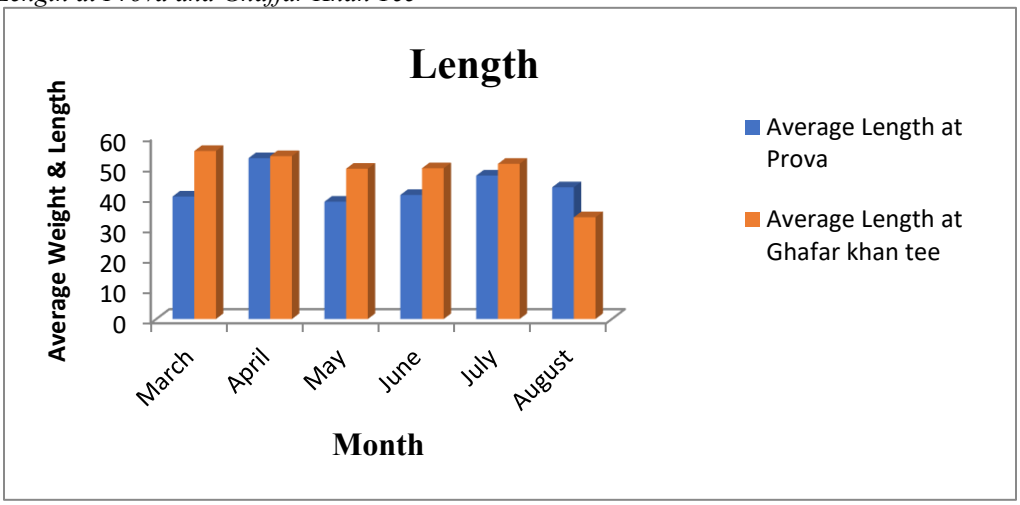


Table 9
Fish Diversity in Length at Two Sites

Month	Average Length at Prova	Average Length at Ghaffar Khan Tee
March	40.21875	55.1333
April	52.78125	53.46667
May	38.5	49.33333
June	40.7	49.46667
July	47.06667	50.93333
August	43.21429	33.4

Figure 10
Diversity of Length at Prova and Ghaffar Khan Tee



Discussion

In the current study, a high level of significance ($p<0.05$) was detected in the analysis of the length-weight relationship (LWR) in Labeo rohita, with a correlation coefficient (r) value of 0.92. The findings of this study demonstrate a strong positive correlation (r) between length and weight in LWR, as indicated by the high correlation coefficient. The findings presented in this study are consistent with previous research conducted on fish populations from various aquatic environments in different geographical locations (Iqbal & Naeem, 2018). The study conducted by Gokhale, Sharma, Sharma, & Upadhyay (2015) provides valuable insights into the morphometric characteristics of the catla hybrid. The findings reveal a strong positive correlation ($P < 0.01$) between total body length and body weight in length-groups A (24-29cm) and C (36-41cm) of the species. The correlation coefficients for these groups were determined to be 0.803 and 0.748, respectively.

The results of the current study demonstrate that groups with greater lengths, when the value of "b" exceeds 3 ($b>3$), exhibit allometric growth. In the present scenario, the obtained value for the variable "b" was 1.64. The findings of this study provide clear evidence of allometric growth in Labeo ohita. The length group G5 exhibited observed values of 4.574, while Pauly *et al.* (1997) reported a range of 2.5 to 3.5 for the value of 'b'. This indicates that the findings of the current investigation align with the observations.

However, when the value of b is much greater or smaller than 3 ($b<3$ or $b>3$), it suggests the presence of algometric growth. When the exponent 'b' is less than 3 ($b<3$) or greater than 3 ($b>3$), it signifies that fish experience a decrease or rise in weight, respectively, as their length increases (Sharma *et al*., 2010).

Kumar, Jain, Munilkumar, Sahu, & Pal (2013) documented a study on the link between total length and weight in Catla, Mrigala, and Siliserh reservoirs of Alwar, Rajasthan. A positive and statistically significant correlation was seen between two parameters, with a correlation coefficient of r = 0.896 in the length group of 60-70 cm. This was followed by the 50-60 cm group, which exhibited a correlation coefficient of r = 0.893, and the 70-80 cm group, which showed a correlation coefficient of r = 0.784. Kumar *et al.* (2013) also documented the range of exponent 'n' values, which varied from 2.837 (50-60 cm) to 3.735 (70-80 cm).

The values of variable 'b' and condition factor 'K' exhibit variations not just among distinct species, but also within the same species throughout different length classes, owing to factors such as sex, maturation stage, and feeding intensity. The present investigation observed variation in the values of 'b' and 'k'. The findings of this study demonstrate a positive correlation between fish length and weight, indicating that as the length of the fish increases, its weight also increases at a rapid rate. Based on the data obtained, it was determined that the weight exhibited a factor of 2.97, a value that closely aligns with the theoretical cube law value of 3.0, which is commonly associated with an ideal fish.

Conclusion

The findings of this study indicate that *Labeo rohita* demonstrates algometric growth, whereby the size of different organs or portions of *Labeo rohita* increases at varying rates. The research findings indicate that the species under investigation displayed negative allometric growth in the River Indus, as evidenced by the value of "b" being less than 3.

Recommendations for Future Research

Further research is necessary to augment the growth of *Labeo rohita* in the River Indus, particularly in the areas of genetic identification, nutrition, and economic feasibility. Efforts should be made to eliminate the unlawful practice of fish predation to mitigate the potential endangerment of the fish fauna within the River Indus.

Declarations

Ethical Approval and Consent to Participate: This study strictly adhered to the Declaration of Helsinki and relevant national and institutional ethical guidelines. Informed consent was not required, as secondary data available on websites was obtained for analysis. All procedures performed in this study were by the ethical standards of the Helsinki Declaration.

Consent for Publication: The authors give their consent for publication.

Availability of Data and Materials: Data will be made available upon request from the corresponding author.

Competing Interest: The authors confirm that there are no conflicts in publishing this article.

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Authors' Contribution: Each of the authors has made substantial contributions to the conception, design, data collection, analysis, and writing of this manuscript. The final copy of the article was read by all authors and submitted.

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