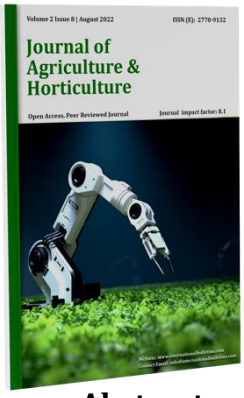

MORPHOMETRIC CHARACTERISTICS OF FISH AND THE CORRELATION RELATIONSHIPS BETWEEN THEM IN THE WATER BODIES OF THE CHIRCHIQ RIVER

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Abstract.
This article provides a scientific analysis of the morphometric indicators of fish inhabiting the water bodies of the Chirchiq River and the correlation relationships between these parameters. The morphometric results reflect the biological condition of the fish populations. The highest growth indicators were recorded for *Ctenopharyngodon idella* (average length 32.7 cm; body weight 512 g), which is attributed to the phytophagous nature of this species and its adequate supply of food resources. A strong positive correlation between fish length and body weight was established, with correlation coefficients ranging from R = 0.96 to 0.98zif8, confirming a close relationship between these morphometric traits.

Keywords: Chirchiq River, morphometric indicators, length, live weight and body indices, biomass, population, correlation coefficient.

Introduction.
In assessing the morphological condition of fish species distributed in the Chirchiq River, morphometric indicators—such as length, live weight, and body indices—serve as key biological criteria. These parameters make it possible to determine growth rate, physiological condition, feeding strategy, and the degree of adaptation to environmental conditions. At the same time, morphological differences among species constitute an important source of information on trophic roles, biomass distribution, and ecological interactions within fish populations. The variability of morphometric parameters is directly related to the hydrological regime of the Chirchiq River, including water temperature, concentrations of biogenic substances, flow velocity, and the stability of food resources [1,3,6]. Therefore, fish length, body weight, and their ratio (length–weight index) are considered essential criteria for assessing the biological status of populations.

Research methodology.
The research was conducted during 2023–2025 at the Department of General Zootechnics and Zootechnologies of Tashkent State Agrarian University. Laboratory experiments were carried out at the Institute of Zoology of the Academy of Sciences of the Republic of Uzbekistan and at the Fisheries Research Center under the Uzbekbaliksanoat Association, as well as in fish farms and natural water bodies located near the Chirchiq River basin.

During the study, a total of 1,184 fish specimens belonging to 7 species representing the main ichthyofauna of the middle and lower reaches of the Chirchiq River were examined. Morphological and morphometric characteristics of fish captured in the Chirchiq River were determined based on classical ichthyological methodologies [2,4,5]. For each specimen, total length (TL), standard length (SL), body weight (W), body depth, fin formula, fin rays, caudal fin shape, and general somatic parameters were measured. Morphometric measurements were

performed using an electronic caliper with an accuracy of 0.01 mm, while body weight was determined using a laboratory balance with an accuracy of 0.01 g.

Research results.

To objectively assess the morphometric condition of fish inhabiting the Chirchiq River, the average length, average body weight, and morphological indices were determined for each species. Table 1 presents a comparative analysis of morphometric differences among species recorded during the study years.

The morphometric indicators presented in the table revealed clear differences in body structure and physiological condition among fish species distributed in the Chirchiq River. The common carp exhibited an average length of 28.4 ± 1.2 cm and an average body weight of 412.0 ± 18.3 g, with a high body index (14.5), indicating a high growth rate and efficient utilization of food resources. The silver crucian carp had an average length of 17.5 ± 0.9 cm and a body weight of 185 ± 11.4 g, with an index of 10.5, which confirms its classification as a fast-reproducing species with a relatively small morphotype.

The roach and rudd were characterized by lower body weight and relatively shorter body length, with body index values of approximately 5.9. These species inhabit vegetated, low-flow sections of the river, and their morphology is adapted to high mobility and metabolic efficiency. Among the species with larger morphometric parameters, grass carp (*Ctenopharyngodon idella*) showed the highest average length (32.7 ± 1.6 cm) and body weight (512 ± 25.7 g), with the highest index value (15.7). This is explained by the phytophagous feeding habit of this species and its high capacity for rapid biomass accumulation.

Table 1. Morphometric indicators of fish occurring in the water bodies of the Chirchiq River (2023–2025)

No.	Latin name	Mean length, cm	Mean weight, g	Length–weight index (W/L)
1	*Cyprinus carpio*	28.4 ± 1.2	412.0 ± 18.3	14.5
2	*Carassius gibelio*	17.5 ± 0.9	185.0 ± 11.4	10.5
3	*Rutilus rutilus*	15.6 ± 0.7	92.0 ± 7.2	5.9
4	*Scardinius erythrophthalmus*	14.8 ± 0.5	88.0 ± 6.1	5.9
5	*Ctenopharyngodon idella*	32.7 ± 1.6	512.0 ± 25.7	15.7
6	*Hypophthalmichthys molitrix*	29.3 ± 1.4	428.0 ± 22.4	14.6
7	*Barbus capito*	18.9 ± 1.0	156.0 ± 9.0	8.2

The silver carp (*Hypophthalmichthys molitrix*) exhibited an average length of 29.3 ± 1.4 cm and an average body weight of 428.0 ± 22.4 g, with a length–weight index of 14.6, indicating its adaptation to the ecological conditions of reservoirs and deep, fast-flowing habitats. **The barbel** (*Barbus capito*) showed a medium morphotype, with an index value of 8.2, reflecting balanced body proportions and adaptation to fast-flowing, rocky-bottom biotopes.

As shown in the table, the morphometric differences observed among species are closely related to their biological characteristics, ecological conditions, and trophic factors. Higher index values were recorded in species capable of accumulating large biomass, whereas lower values were characteristic of small- and medium-sized morphotypes.

To further assess the morphometric characteristics of fish species occurring in the Chirchiq River, the correlation between two key biological indicators—mean body length and mean body weight—was analyzed (Figure 1).

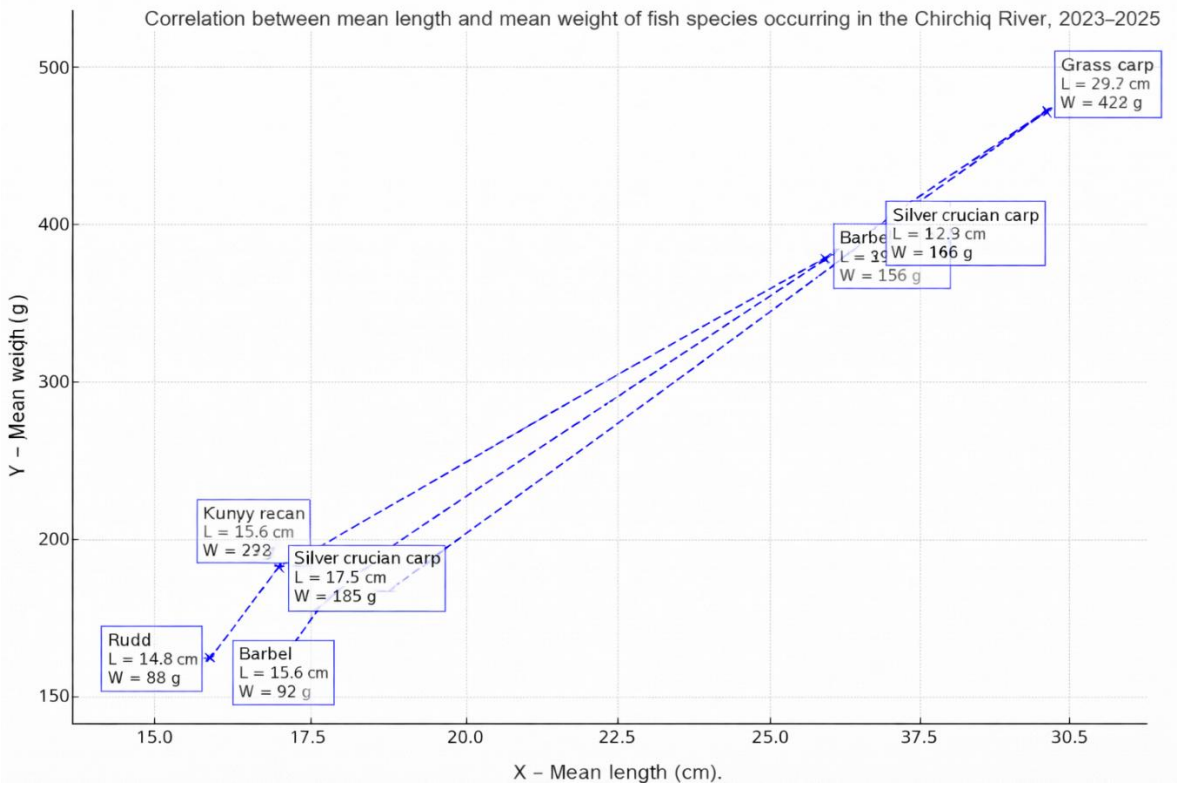

Figure 1. Correlation between length and weight of fish species occurring in the water bodies of the Chirchiq River, 2023–2025.

In morphometric studies, these two parameters reflect the physiological growth rate of fish, their capacity for biomass accumulation, feeding strategy, and degree of adaptation to environmental conditions.

The length–weight relationship of fish inhabiting the Chirchiq River is considered one of the key criteria for understanding the biological status of fish populations. During the study, the mean body length (X) and mean body weight (Y) of each species were determined and presented on a correlation graph. Each point on the graph represents the average morphological condition of a particular species. Annotation blocks placed next to the points indicate the species name, body length, and body weight, making the graph clearer and more convenient for comparison.

The dense clustering of points around a single trend line and the smooth, continuously upward direction of the blue dashed regression line indicate that body weight increases steadily with increasing length. For example, the species with the largest morphometric parameters—grass carp (*Ctenopharyngodon idella*) and silver carp (*Hypophthalmichthys molitrix*)—are positioned at approximately 29–33 cm in length and 428–512 g in weight, clearly demonstrating their high capacity for intensive biomass accumulation. In contrast, smaller species such as rudd, roach, and barbel are located at lower values of both length and weight, reflecting their ecological role as small morphotypes adapted to specific environmental conditions.

Overall, these patterns are clearly visualized in the graph, allowing for rapid and intuitive interpretation of morphological differences among species.

To assess the relationship between length and weight, the Pearson correlation coefficient was calculated, yielding a value of **r = 0.994**. This represents an almost perfect positive correlation, indicating an extremely strong relationship between fish length and body weight. In other words, the longer the fish body, the greater its biomass. The correlation was calculated using the following formula:

$$r = \Sigma(x - \bar{x})(y - \bar{y}) / \sqrt{[\Sigma(x - \bar{x})^2 \cdot \Sigma(y - \bar{y})^2]}$$

where X – mean length (cm), Y – mean body weight (g), $\bar{x}$ – mean value of X, $\bar{y}$ – mean value of Y

In addition, as an auxiliary biological criterion, the **length–weight index** was calculated to evaluate the proportional growth of each species using the formula **I = W / L**. Higher index values (e.g., in common carp, grass carp, and silver carp) indicate rapid growth and high biomass accumulation, whereas lower index values are characteristic of small- and medium-sized morphotypes.

Thus, the length–weight correlation graph fully revealed the natural regularities in the morphology of Chirchiq River fish. The interrelated formation of growth rate, biomass distribution, and ecological niches among species was scientifically substantiated.

Conclusions

The morphometric results clearly reflected the biological condition of the fish species. The highest growth indicators were recorded for *Ctenopharyngodon idella* (mean length 32.7 cm; mean weight 512 g), which is explained by the phytophagous feeding habit of this species and the availability of sufficient food resources.

The length–weight relationship of the studied fish species was characterized by a high degree of correlation. The strong positive correlation identified in the study (r = 0.96–0.98) confirms that biological growth proceeds in a uniform and stable manner. As length increases, body mass increases in an almost proportional way.

Individual growth rates varied among species. *Cyprinus carpio* and *Ctenopharyngodon idella* exhibited higher morphometric index values, which can be explained by the well-developed muscular and skeletal system and their adaptation to intensive growth

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