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Morphometric and Meristic Characterization of the Primary Freshwater Fishes in Agra

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Abstract - The Yamuna River was sampled for 24 morphometric metrics and eight meristic count parameters for each fish species. There was a wide variation in length and weight for the Cyprnius carpio (14-18 cm), Mahseer (21–28 cm), Labeo rohita (20–26 cm), Xenontodon canceilia (17–25 cm), and other species throughout the research period. There is a larger growth rate shown by the regression coefficient 'b.' Although Xenontodon canceilia res was found to be the longest, it had the shortest pelvic fin length for standard length, whereas Cyprnius carpio was found to be the longest, with the shortest pelvic fin length for standard length.

Keywords - Morphometric, meristic parameters, Fish species

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INTRODUCTION

Fish populations in freshwater settings are decreasing on a daily basis owing to a variety of issues, including habitat deterioration, overfishing, pollution, and a lack of effective management and conservation methods for fish and their resources (Odo et al., 2009). To preserve fishing resources, it is essential that a plan be devised that would provide an insight into the health of the fish. It is regarded as a foundational tool for the study of fish health and the conservation and management of fish populations and mass. Using the LWR, it is possible to estimate stock biomass and compare fish populations across areas (Ayoade & Ikulala, 2007). LWR studies are now now regarded significant biological markers to create data on the growth conditions of fish species in both wild and cultivated environments.

Aside from its involvement in fish biology, it is also important in determining the health of the fish in its environment and its physiological and biological status. In addition, it gives data on the development and dynamics of fish populations (AL Nahdi et al., 2006). Ascertaining and connecting the population by formulating yield equations, the LWR provides data on fisheries' management, and so base line data on stock conditions may be obtained both regionally and temporally.

Furthermore, it may be used to research fish feeding rates, gonad development, and fish maturation phases (Beyer, 1987). LWR data, on the other hand, varies across species because of hereditary body form and physiological aspects, such as maturation and spawning (Schneider et al., 2000). Freshwater fisheries will continue to play an essential part in global social and economic development as long as they can be sustained for commercial reasons.

This technique is frequently used in fisheries management since it offers information on stock density, biomass, breeding grounds and seasons, health condition and availability of the fish. LWRs research. These days, the research of vulnerable fish species' LWRs covers the most essential biological factors that offer information on the development and condition of fish species and the total fish population. Also critical to fisheries research, management, and conservation are the findings of this study.

LITREATURE REVIEW

SEPTIANA SRI ASTUTI (2020) In order to study fish populations, morphometric asymmetry, and evolutionary changes, truss morphometry analysis is often performed. Barbodes binotatus' symmetrical and asymmetrical distribution patterns will be examined in a number of Indonesian regions, including Java, Bali, Nusa Tenggara, Sumatera, Kalimantan, and Sulawesi. 28 sampling locations yielded a total of 845 samples for analysis. The tpsDig.2 application was used to analyse digital

images and landmark locations. SAGE software was used to determine the symmetry-asymmetry degree of fishes from each site based on conventional landmarks, truss morphometry, and geometric-morphometric analysis. This study's findings revealed an extreme degree of asymmetry (P0.0001). Research on genetic populations and the presence of genes that influence an individual's body's degree of asymmetry is still required.

Shahid Mehmood (2021) In addition to comparing different fish populations, length-weight relationships (LWRs) are a propondral indicator used to evaluate the overall health of the fish via numerous growth-related markers. An investigation on the characteristics of three food fish species found in the Rajouri River in the North-Western Himalayan area, including Tor putitora, Labeo dero (Karah), and Schizothorax richardsonii (Lass), was conducted in this research. From June 2019 to May 2020, gill and cast nets were used to capture specimens of T. putitora, L. dero, and S. richardsonii (45, 40, 40, respectively). For T. putitora and L. dero, the 'b' value was 3.187, showing a positive allometric growth (b > 3) for both species. S. richardsonii, on the other hand, had a 'b' value of 1.915 and allometric growth that was negative (b 3). T. putitora, L. dero, and S. richardsonii all had regression coefficients of 0.95, 0.94, and 0.91, respectively. All three fish species have condition factors close to 1, suggesting that the surrounding environment is conducive to their development. Additional morphometric characteristics and six meristic counts were also evaluated, where morphometric characters revealed a steady rise in relation to body length, but meristic counts remained constant with regard to the increase in body length. Using the information gathered, it is possible to devise a cost-effective plan for managing and conserving fish populations and their biomass.

Subodh Kumar Tripathy (2020) Measurable or metric characters are fish morphometric characteristics. For the study of creatures' size and form variations, morphometrics employs a huge number of statistical processes that are mostly intertwined. In order to address evolutionary shape change ideas, morphometrics and phylogenetics of a species are coupled. A species' population structure may be evaluated and stocks can be identified on the basis of morphometric differences among the species' several stocks. As morphometrics developed, it provided researchers with sophisticated tools for investigating and visualising shape variations, separating form from size variation, and finding species populations that have distinct and useful morphological traits. In order to keep abreast of new developments in science and technology, enhanced techniques of traditional morphometry have been developed throughout time. It has been bolstered by these new techniques to enhance and update fisheries studies across the world.

Paul S.K (2020) In Bangladesh, the Batasi fish is a freshwater small indigenous species (SIS) identified as Neotropius atherinoides. Using data from Bangladesh's Chalon beel River, this research is the first to provide a comprehensive picture of the length-weight connections (LWR), length-length relationships (LLR), condition factors (K F; K R) and breeding biology in the area. With a magnifying glass and digital slide callipers with 0.01 cm accuracy, the total number of fin rays was counted and various lengths were measured. A digital balance was used to determine the subject's BW to within 0.01 g of precision. The following mean changes in fin formula were discovered in this study: Dorsal, D. 1/3 -6; Pectoral, Pc. 1/4 -7; Pelvic, Pv. 3 -7; Anal, A. 30 -45; and Caudal, C. 16 -20. These are all small but significant. Because of the linear relationship (LLRs) and LLR value (r 0.94), it was clear that they were closely linked. Calculated allometric growth (b>3.00) indicates positive allometric growth with a strong correlation coefficient for combined sexes in length-weight correlations (W=AL b). The habitat (Cholon beel) has an excellent condition factor score (K>1.0). The species' spawning season began in April, as shown by the month's highest mean GSI value (21.344.87). When compared to GSI, fecundity with body weight, and standard length, breeding parameters showed superior connections. Fisheries management, species identification, and the relative condition of fish are all influenced by these characteristics.

S Ndobe (2019) The climbing perch, Anabas testudineus Bloch 1972, is a prominent freshwater fish in South and Southeast Asia. Meristic counts and the length-to-weight ratio of climbing perch were studied in Sigi District in Central Sulawesi, Indonesia, which is near the eastern limit of the species' range. Weighing and measuring specimens collected from wetlands in the Sigi District yielded the length–weight relationship and meristic counts. It is 2.98 for males and 3.06 for women when it comes to the length-to-height ratio. The maximum length of L was 163 millimetres. Meristic calculations were based on the median values D, XVII+8, A, X-9, P, 13; V, I+5, C, 16. Both male and female climbing perch had a mean scale count of 31 longitudinal and 15 vertical scales. Meristic traits showed no substantial sex differences between the sexes. Males had a modest allometric negative tendency,

despite the overall development pattern being isometric. In line with other signs of a crowded population, the low maximum size of wetlands underscores the need of long-term, comprehensive wetland management. Considerable meristic character variability may imply high genetic variety and/or adaptability in the setting of domestication, which may allow for selective breeding.

MATERIAL AND METHODS

The following is a sample collection: From April 2017 to March 2018, researchers studied morphometric and meristic factors in four separate sample zones of the Yamuna River. Twenty fish specimens of four species (Cyprnius carpio, Mahseer, Labeo rohita and Xenontodon canceilia) from the Yamuna River were analysed. Locally recruited professional fishermen and fish anglers were used to gather the fish sample from each of the zones. Gill nets and cast nets were used to gather fish samples, as were drag nets and small nets. Samples of fish were also taken from a nearby market. The gill net was used at least ten times and the cast net was used twenty times in each zone, covering roughly 1002 metres of river segment and allowing 3–5 minutes of settling periods for each cast, at all locations. For the investigation of morphometric and meristic characteristics, 20 fish specimens were kept in 10% formalin in the specimen jar and maintained there. An electronic balance (Wensar weighing scales limited, model no. PGB, digital vernier calliper, and metre tape etc.) was used to measure the specified morphometric and meristic characteristics. According to Day (1875–78), Talwar and Jhingran (1991) and Jayaram (1991), all measurements and counts were carried out in the laboratory for each species (2010). In grammes (g), the total weight of all fish samples, as well as their morphometric characteristics All fish samples should be measured in centimetres (cm).

In order to do statistical analysis, we determined the mean values and standard deviations for each of the four species of fish.

For Morphometric Parameters, below is the regression equation: The following morphometric parameters were regressed using the formula:

$$Y = a + b X$$

Morphometric variables such as fork length, pre-dorsal length and standard length; 'a' is the constant value and 'b' is the regression coefficient are used in this equation.

DATA ANALYSIS

Morphometric and meristic characteristics were the focus of current research from April 2017 to March 2018. In order to conduct morphometric and meristic parameter analysis, 20 preserved specimens of each of the four fish species studied were measured. There were twenty-four morphometric characteristics assessed and eight meristic counts made for each of the Yamuna River's fish species throughout the research. Cyprnius carpio, Mahseer and Labeo rohita, as well as Xenontodon canceilia, showed a proportionate increase in total length under the study (range and meanS.D. value) in Table 1 Characteristics of Morphometric characters such as the weight of specimen and the range and meanS.D. values of Morphometric characters such as the weight and total length of the specimen and the length of the fork and fork base, pelvic fin, pelvic spine, and pectoral and caudal fin, as well as length of the upper and lower jaws, snouts, and helixes. In addition to the dorsal fin ray, anal fin, caudal fin, pectoral fin, and pelvic fin, meristic counts were performed on Cyprnius carp, Mahseer and Xenontodon canceilia along with lateral line scales and scales above and below the lateral line. Table 2 displays the meristic count values for all fish species.

Table 1: Morphometric measurements of selected fish species from YamunaRiver (Mean±S.D.)

Morphometric	Cyprnius carpio		Mahseer		Labeo rohita		Xenontodon canceilia	
Measurements	Range	Mean±S.D.	Range	Mean±S.D.	Range	Mean±S.D.	Range	Mean±S.D.
Weight (g)	60–78	69±8.0	120–185	152.5±24.61	100–160	130±22.12	20–34	27±5.10
Total Length	14–18	16±1.52	21–28	24.5±2.58	20–26	23±2.21	17–25	21±3.01
Fork Length	12.7–17	14.75±1.59	17.5–25	21.25±2.86	19–25	22±2.20	164–24.5	20.45±3.02
Standard Length	11.2–16	13.6±1.73	16.4–24.2	20.3±2.94	18–24	21±2.20	15.7–24	19.85±3.08
Pelvic Fin Length	1.5–2.1	1.8±0.22	2.5–3.9	3.2±0.55	2.5–3.5	3±0.38	0.2–0.35	0.275±0.06
Pelvic spine length	1.5–2.1	1.8±0.22	2.5–3.9	3.2±0.55	2.5–3.5	3±0.38	0	0
Pectoral fin length	2–3.3	2.65±0.48	3–3.9	3.45±0.33	3–4	3.5±0.38	0.8–1	0.9±0.07
Caudal fin length	2.5–3.4	2.95±0.33	5–5.9	5.45±0.34	4–5.5	4.75±0.58	1–1.5	1.25±0.18
Pre-dorsal length	5. 7–6.4	6.05±0.31	8.5–10	9.25±0.55	6–7.5	6.75±0.56	11–19	15±2.92
Pre-anal length	9–10	9.5±0.40	11–16	13.5±1.74	10.5–13.5	12±1.15	11–19	15±2.92

Pre-pectoral length	3.4–3.8	3.6±0.16	4–5.5	4.75±0.59	3–4.2	3.6±0.45	6–6.5	6.25±0.18
Pre-pelvic length	6.1–6.8	6.45±0.27	8–12	10±1.50	7–8.5	7.75±0.57	7–16	11.5±3.46
Length of Dorsal fin base	5.7–6.4	6.05±0.31	2–3.5	2.75±0.56	4–5	4.5±0.37	1.8–2.6	2.2±0.29
length of anal fin base	1.1–2.1	1.6±0.42	1–2	1.5±0.36	0.7–1.3	1±0.23	2–2.9	2.45±0.34
Dorsal fin length	2–2.9	2.45±0.35	4–5.3	4.65±0.47	3–4.5	3.75±0.57	1–1.5	1.25±0.18
Upper jaw length	2.95–3.75	3.35±0.33	2–3.5	2.75±0.56	1.6–2.5	2.05±0.34	5–5.6	5.3±0.23
Lower jaw length	2.2–2.8	2.5±0.25	1–2.3	1.65±0.45	1–1.9	1.45±0.07	5.7–6.2	6.66±0.19
length of caudal peduncle	3–3.95	3.475±0.39	4.2–5.3	4.50±0.41	2.4–3.2	2.8±0.31	0.1–0.3	0.2±0.07
Body Depth	6–7.2	6.6±0.52	6–7.5	6.75±0.53	6–7.5	6.75±0.56	1–1.4	1.2±0.15
Maxillary barbless	2 pairs	2 pairs	2 pair	2 Pair	1 pair	1 pair	0	0
Snout Length	1.2–1.9	1.55±0.29	1–2.5	1.75±0.55	1–1.9	1.45±0.34	3–3.6	3.3±0.23
Eye diameter	1.1–1.9	1.5±0.31	0.7–1.2	0.95±0.18	0.14–0.3	0.22±0.06	0.1–0.5	0.3±0.16
Head Length	4.2–4.9	4.55±0.36	3.5–4.9	4.2±0.52	2.1–3	2.55±0.34	4–5.2	4.6±0.46
Depth of Caudal Peduncle	2–2.98	2.14±0.40	2–3.5	2.75±0.56	1–1.9	1.45±0.20	0.5–0.9	0.7±0.15

Table 2: Meristic counting of selected fish species from Yamuna River

Counts	Abbreviation	Cyprnius carpio (Range)	Mahseer (Range)	Labeorohita (Range)	Xenontodon canceilia (Range)
Dorsal fin ray	DFR	21(3–4/18–20)	12(3/9)	14–16(3/11–13)	15–16
Anal fin ray	AFR	8(3/5)	8(2–3/5)	7(2/5)	17–18
Caudal fin ray	CFR	3/17–19	19	19	15
Pectoral fin ray	PFR	15	19	17	10–11
Pelvic fin ray	PEFR	8	9	9	6
lateral line scale	LLS	33–37	22–26	40–42	0
Above Lateral line Scale	ALtr	5–6	41/4	05–07	0
Below lateral line scale	BLtr	5–6	21/2	05–07	0

As fish length increased, the morphometric parameters increased in a proportionally positive manner. Ujjania et al. (2012) also found that when fish length increased, positive growth was reported in morphometric parameters. All length groups of fish with varying body lengths had meristic counts that were practically same, hence it can be stated that meristic counts were not influenced by body size. The maximum morphometric parameters in relation to total length were found for Cyprnius carpio when standard length was used and the lowest in pelvic fin length; for Mahseer when standard length was used and the lowest in pectoral fin length; for Fork and standard length and the highest in caudal peduncle length in Labe There was a positive link between Morphometrics and Total length if the correlation coefficient 'r' was greater than 0. (Table 3). r=0.995 and r=0.961, respectively, for Cyprinus carpio showed a positive correlation between total length and fork length, indicating that total length is positively correlated with fork length. There is a strong association between total length and caudal fin length for Mahseer, with a correlation value 'r' of 0.993 for the caudal fin and 0.944 for head length. When comparing the total length of Labeo rohita to the length of the fork&standard length, the correlation coefficient 'r' was highest (r=0.998) and the length of the caudal peduncle was lowest (r=0.938), indicating a positive connection with total length. In Xenontodon canceilia, there was a substantial association between total length and fork length and standard length and a smaller correlation between total length and pectoral fin length.

Table 3: Regression equation of Morphometric parameters of selected Fish from Yamuna River (p=0.05)

Parameters	*Cyprnius carpio*		Mahseer		*Labeo rohita*		*Xenontodon canceilia*	
	Regression equation	Correlation coefficient 'r'	Regression equation	Correlation coefficient 'r'	Regression equation	Correlation coefficient 'r'	Regression equation	Correlation coefficient 'r
Fork Length (Y) on total length (X)	Y=1.045x–1.802	0.995	Y=1.101x–5.500	0.984	Y=0.995–0.904	0.998	Y=1.001x–0.579	0.999
Standard Length (Y) on total length (X)	Y=1.115x–4.012	0.982	Y=1.132x–7.224	0.986	Y=0.995x–1.904	0.998	Y=1.020x–1.492	0.999
Pelvic Fin Length (Y) on total length (X)	Y=0.146x–0.552	0.985	Y=0.208x–1.923	0.96	Y=0.169x–0.940	0.984	Y=0.018x–0.100	0.972
Pectoral fin length (Y) on total length (X)	Y=0.311x–2.320	0.972	Y=0.126x+0.307	0.981	Y=0.169x–0.440	0.984	Y=0.022x+0.413	0.915
Caudal fin length (Y) on total length (X)	Y=0.215x–0.474	0.961	Y=0.129x+2.257	0.993	Y=0.255x–1.217	0.963	Y=0.059x+0.035	0.953
Dorsal fin length (Y) on total length (X)	Y=0.232x–1.245	0.989	Y=0.178x+0.261	0.969	Y=0.254x–2.160	0.984	Y=0.059x+0.026	0.974
length of caudal peduncle (Y) on total length (X)	Y=0.253x–0594	0.965	Y=0.157x+0.838	0.965	Y=0.135x–0.392	0.938	Y=0.024x–0.304	0.979
Head Length (Y) on total length (X)	Y=0.236x+0.679	0.980	Y=0.195x–0.688	0.944	Y=0.150x–0.972	0.973	Y=0.150x+1.455	0.990

There is a positive association between overall length and (r=0.915) Additionally, the Morphometric characteristics of Mahseer (Tor tor) in River Narmada have a favourable link with Mahseer's overall length. It was also noted in the research of Tor putitora morphometric and meristic characteristics of Gobindsagar reservoir and the Yamuna River between Rishikesh and Haridwar by Thermal factor (Period of incubation) Barlow 1961 and Gould 1956 are only two examples of environmental influences on fish morphometric character. Tanning noted in 1944 that the number of species with unpaired fins and rays varies depending on the density of the water in which they live. Hydrographic conditions may potentially have an effect on body proportion, according to a number of authors (Hubbs 1922 and Barlow 1961). The results of this research suggest that the proportionate growth rate of fish species increases with the length of the fish and has a greater positive association with the total length of the fish in the

Yamuna River. Consistent meristic counts were discovered. All measurements were taken on formaldehyde preserved specimens after 10–20 days of fixation, thus there may be some limits. As a result of shrinkage and partial dehydration, the preserved specimen's total length and total weight change.

CONCLUSION

Overfishing, habitat degradation, pollution, and a lack of efficient management and conservation measures for fish and their resources all contribute to the decline of fish populations in freshwater environments (Odo et al., 2009). Current study was focused on morphological and meristic traits between April 2017 and March 2018. Variations in weight and length were observed for a variety of species, including Cyprnius carpio (14–18 cm) and Mahseer (21–28 cm), as well as Labeo rohita (20–26 cm) and Xenontodon canceilia (17–25 cm). The regression coefficient 'b.' indicates a higher rate of growth. This fish had the longest total body length and the smallest pelvic fin length in the case of standard length (b=1.132), Mahseer (b=1.132), Labeo rohita (b=0.995), and Xenontodon canceilia res (b=1.020). Both the overall length and weight of the preserved specimen vary due to shrinking and partial dehydration.

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