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Morphometric analysis of *Channa striata* in the Jumar River, Ranchi District and its implications

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Abstract- This report aims to establish the morphometrics of *Channa striata* in the Jumar River in context with the environmental variation and correlation of morphology of fish. From ninety specimens, body measurements and fin length data were recorded. By applying the statistical techniques to the collected samples' measurable morphometric characters, it has been shown that there exist regional and environmental impacts on the characters with reasonable correlation with body and fin length. The study shows the influence of environmental conditions on fish morphology and indicates some prospects for the protection and use of specific species. These results provide useful knowledge in understanding the ecological characteristics of *Channa striata* and helps to provide guidelines for environmental protection.

Keywords:*Channa striata*, morphometric variation, environmental factors, Jumar River, fisheries management, conservation.

INTRODUCTION

Channa striata is characterised by its serrated jaws, hence the common name of snakehead. The striped snakehead is a predatory fish that is native to the fresh waters of South Asia, including India. According to Duong *et al.* (2019)[1], it is known to be a significant predator and, at the same time, prey in the aquatic environment, hence enhancing the balance of the ecosystem. This species is also beneficial for purposes of income, food, and trade; through fishing and aquaculture. *Channa striata* is a commonly found fish of the Jumar River, Ranchi District, but data on the morphometric features of the fish in this region remains scarce.

Morphometric investigations are very crucial in the study of fishes because these bring out the differences in shape and size of fish in relation to the changes in their habitats. Such studies are particularly relevant for the *Channa striata* in the Jumar River to determine its population density, growth rate and effect that it may have on the ecosystem. It is, therefore, important to understand these differences in an effort to manage and conserve the species.[2]

The study aims to achieve the following objectives:

- To analyse the morphometric variation of *Channa striata* within different regions of the Jumar River.
- To assess the correlation between environmental factors and morphometric traits in *Channa striata.*
- To evaluate the implications of morphometric differences for local fishery practices.
- To contribute to the conservation efforts by providing baseline data on the morphometric characteristics of *Channa striata* in the Jumar River.

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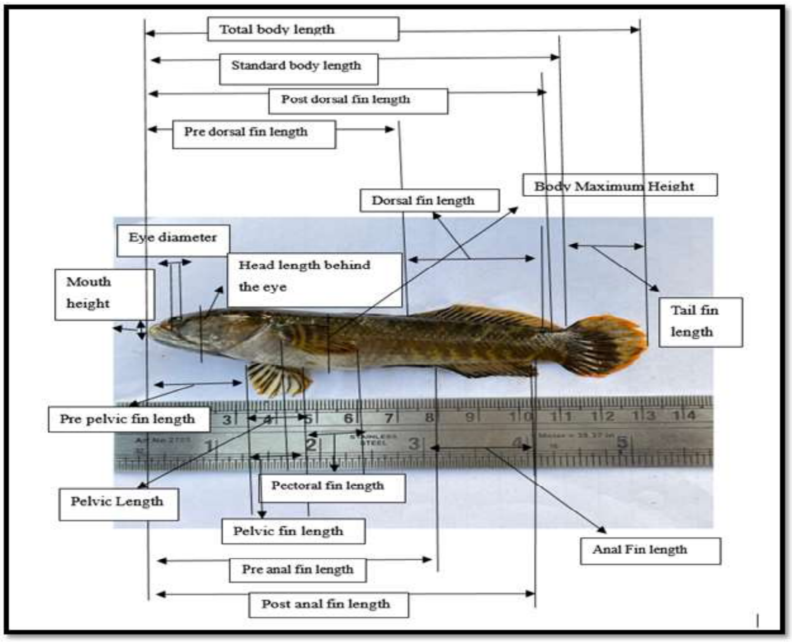

Figure 1- Morphometric data of *Channa striata*
(Source: Influenced by Duong *et al.*, 2019)[1]

Morphometric Variation and Environmental Correlations in Freshwater Fish

Duong *et al.* (2019)[1] opined that *Channa striata* appearing in the cultured and wild populations possess different morphometric alternations, meaning that morphological distinction has occurred due to significant environmental and cultural impacts. For this reason, wild fish stock is always more diverse morphometrically than cultured fish stock, and this is well supported by the adaptation to the wild environment.

Tresnati and Fachruddin (2019)[3] expounded on the fact that there is a difference in the concept of sex and gonadal development in *Channa striata* in order to buttress the argument on Morphometric Variability. This demonstrates the influence of reproductive factors on other aspects of an organism especially morphological characteristics. This implies that, when using morphometric analyses, one should take into consideration, variables that are biological besides the matters of the environment.

Implications of Morphometric Analysis for Fisheries Management and Conservation

As aptly noted by Zhou *et al.* (2022)[4], analysis of the phylogenetic tree of the *Channa* species relying on the morphometric characters yielded vital information about its evolution as well as robustness and underlined the importance of morphometric data in fisheries management. According to Othman *et al.* (2022)[5] hypothesis, a wide range of asymmetrical traits is vulnerable to numerous stimuli, including fluctuating asymmetry in eye diameter, which is a perfect signal of development instability and environmental pressures, particularly with reference to the morphometric data in ecological health and pollution.

As pointed out by Dewita *et al.* (2022)[6], there is adequate evidence that stresses the nutritional qualities and the nutritional value of *Channa striata* to improve health outcomes. On the other hand, combining morphometric and biochemical data helps to have a full assessment of the species' status and its relationship with the environment, which are crucial in formulating effective management and conservation strategies. The integrated approach adopted here enhances the conservation of the *Channa striata* population and their habitats.

MATERIALS & METHODS

Study Area

The Jumar River is a freshwater river that flows through Ranchi District and has features of meandering with various types of structures of aquatic ecosystems. This river, containing a good number of carp, is home to *Channa striata*, which plays an important role in both ecological and economic aspects. Some of the stretches of the river considered in the study cover different water regimes and vegetation that determine the distribution of fish species.

Sample Collection and Morphometric Measurements

Samples of *Channa striata* were obtained from the rivers through electro-shocking in the period of June-August 2023 to facilitate an adequate sample of 90 individuals. The ethical concern was followed to the extent that the impact on the specimens was kept to a minimum by not stressing them. Biological measurements consists of total body length, standard length, post-orbital head height, intact fin length and fragmented fin length, body maximum height, anal fin length, tail fin length, mouth height, eye diameter with the help of digital callipers and measuring boards.[7] The collected data was subjected to multivariate and regression analysis using tools like Microsoft excel to look for trends and relationships between the morphometric parameters.

RESULTS

Morphometric Variation Across Different Regions of the Jumar River

Table 1: Descriptive Statistics for morphometric analysis

Total Body Length		Standard Length		Post Dorsal Fin Length	
Mean	13.67555556	Mean	11.25333333	Mean	10.56266667
Standard Error	0.190093683	Standard Error	0.157081688	Standard Error	0.144817747
Median	13.9	Median	11.4	Median	10.65
Mode	14.6	Mode	10.8	Mode	10.2
Standard Deviation	1.80338702	Standard Deviation	1.490207738	Standard Deviation	1.373861776
Sample Variance	3.252204744	Sample Variance	2.220719101	Sample Variance	1.88749618
Kurtosis	0.663321645	Kurtosis	0.847506035	Kurtosis	0.762307772
Skewness	-0.700258396	Skewness	-0.689196845	Skewness	-0.673832211
Range	9	Range	7.7	Range	6.9
Minimum	8.7	Minimum	7	Minimum	6.7
Maximum	17.7	Maximum	14.7	Maximum	13.6
Sum	1230.8	Sum	1012.8	Sum	950.64
Count	90	Count	90	Count	90

Table 2

Pre-Dorsal fin Length		Post Anal Fin Length		Pre-Anal Fin Length	
Mean	4.164444444	Mean	10.14777778	Mean	6.318888889
Standard Error	0.057546835	Standard Error	0.137084205	Standard Error	0.088289254
Median	4.2	Median	10.3	Median	6.5
Mode	3.9	Mode	10.9	Mode	6.6
Standard Deviation	0.545937213	Standard Deviation	1.30049496	Standard Deviation	0.837585407
Sample Variance	0.298047441	Sample Variance	1.691287141	Sample Variance	0.701549313
Kurtosis	1.724911515	Kurtosis	0.752673763	Kurtosis	0.740241783
Skewness	-1.141573202	Skewness	-0.883774552	Skewness	-0.711642111
Range	2.8	Range	6.3	Range	4.4
Minimum	2.3	Minimum	6.4	Minimum	4
Maximum	5.1	Maximum	12.7	Maximum	8.4
Sum	374.8	Sum	913.3	Sum	568.7
Count	90	Count	90	Count	90

Table 3

Pre-Pectoral Fin Length		Pre-Pelvic Fin Length		Body Max Height	
Mean	3.607777778	Mean	4.145555556	Mean	2.234444444
Standard Error	0.047646948	Standard Error	0.060504766	Standard Error	0.047592767
Median	3.6	Median	4.2	Median	2.3
Mode	3.4	Mode	4	Mode	2.5
Standard Deviation	0.452018638	Standard Deviation	0.573998612	Standard Deviation	0.451504628
Sample Variance	0.204320849	Sample Variance	0.329474407	Sample Variance	0.203856429
Kurtosis	1.052113177	Kurtosis	0.732603128	Kurtosis	-0.481758722
Skewness	-0.684992208	Skewness	-0.649493819	Skewness	-0.297323817
Range	2.3	Range	2.9	Range	2
Minimum	2.2	Minimum	2.6	Minimum	1.1
Maximum	4.5	Maximum	5.5	Maximum	3.1
Sum	324.7	Sum	373.1	Sum	201.1
Count	90	Count	90	Count	90

Table 4

Eye Diameter		Mouth Height		Dorsal Fin length	
Mean	0.75	Mean	1.922222222	Mean	7.308888889
Standard Error	0.011201257	Standard Error	0.039211255	Standard Error	0.113832832
Median	0.7	Median	2	Median	7.35
Mode	0.7	Mode	2	Mode	7.6
Standard Deviation	0.106264457	Standard Deviation	0.37199063	Standard Deviation	1.079913068
Sample Variance	0.011292135	Sample Variance	0.138377029	Sample Variance	1.166212235
Kurtosis	-0.307772884	Kurtosis	2.339039676	Kurtosis	0.347582976
Skewness	-0.02872943	Skewness	-1.823883936	Skewness	-0.566294467
Range	0.5	Range	1.7	Range	5.2
Minimum	0.5	Minimum	0.8	Minimum	4.3
Maximum	1	Maximum	2.5	Maximum	9.5
Sum	67.5	Sum	173	Sum	657.8
Count	90	Count	90	Count	90

Table 5

Anal Fin Length		Pectoral Fin Length		Pelvic Fin Length	
Mean	4.608888889	Mean	2.371111111	Mean	0.98
Standard Error	0.075229892	Standard Error	0.03188793	Standard Error	0.015336427
Median	4.7	Median	2.4	Median	1
Mode	4.4	Mode	2.4	Mode	1
Standard Deviation	0.713693423	Standard Deviation	0.302515463	Standard Deviation	0.145494121
Sample Variance	0.509358302	Sample Variance	0.091515605	Sample Variance	0.021168539
Kurtosis	0.250141612	Kurtosis	1.186548073	Kurtosis	1.911149466
Skewness	-0.350150346	Skewness	-0.690660617	Skewness	0.088650243
Range	3.6	Range	1.7	Range	0.9
Minimum	2.7	Minimum	1.4	Minimum	0.6
Maximum	6.3	Maximum	3.1	Maximum	1.5
Sum	414.8	Sum	213.4	Sum	88.2
Count	90	Count	90	Count	90

Table 6

Tail fin Length		Head Height Behind Eye	
Mean	2.46	Mean	1.784222222
Standard Error	0.031396939	Standard Error	0.028244508
Median	2.5	Median	1.8
Mode	2.5	Mode	1.7
Standard Deviation	0.297857518	Standard Deviation	0.267950934
Sample Variance	0.088719101	Sample Variance	0.071797703
Kurtosis	0.13844518	Kurtosis	0.582564768
Skewness	-0.297753685	Skewness	-0.233762359
Range	1.5	Range	1.3
Minimum	1.6	Minimum	1.1
Maximum	3.1	Maximum	2.4
Sum	221.4	Sum	160.58
Count	90	Count	90

Morphometric variation of *Channa striata* living in the Jumar River stands out significantly, showing variations by the region. The mean total body length of the subjects that participated in this research was 13.68 cm with a standard deviation of 1.80cm, and the mean standard length was 11.25cm with a standard deviation of 1.49 cm. A little disparity in the length of the body after the dorsal fin (mean = 10.56 cm, SD = 1.37 cm) and the maximum body height in adults (mean = 2.23 cm, SD = 0.45 cm) was also noted. The skewness and kurtosis coefficients exhibited negative skew and variability in the kurtosis values, indicating that morphometric distribution is heterogeneous concerning measurements. As pointed out by Setyaningrum *et al.* (2022)[8], such distinctions might be a result of the splitting of the environment or genetic variation. Djumanto *et al.* (2020)[9] opine that these morphometrics explain growth and reproductive modalities. These findings suggest a need for management practices to be tailored to the region for fisheries as well as conservation.

Relationship Between Environmental Factors and Morphometric Traits

Table 7- Regression analysis for the relationship between morphometric traits and environmental factors

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.998625932							
R Square	0.997253752							
Adjusted R Square	0.996651834							
Standard Error	0.10434999							
Observations	90							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	16	288.651331	18.04070819	1656.794951	1.12695E-86			
Residual	73	0.794891183	0.01088892					
Total	89	289.4462222						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.113447992	0.120225623	-0.943625733	0.348473581	-0.353057313	0.12616133	-0.353057313	0.12616133
Standard Length	0.74963781	0.084842107	8.835681185	3.78648E-13	0.580547735	0.918727886	0.580547735	0.918727886
Post Dorsal Fin Length	0.175467332	0.081670395	2.148481479	0.034993082	0.012698469	0.338236195	0.012698469	0.338236195
Pre Dorsal fin Length	0.085828914	0.103011568	0.833196847	0.407451568	-0.119472845	0.291130673	-0.119472845	0.291130673
Post Anal Fin Length	0.054082956	0.089467011	0.604501646	0.547384485	-0.124224541	0.232390452	-0.124224541	0.232390452
Pre Anal Fin Length	0.25457793	0.101077046	2.518652259	0.013971456	0.053131668	0.456024192	0.053131668	0.456024192
Pre Pectoral Fin Length	-0.084983009	0.152235506	-0.558233825	0.578392896	-0.388387934	0.218421917	-0.388387934	0.218421917
Pre Pelvic Fin Length	0.024589736	0.086987951	0.282679793	0.778222297	-0.148777	0.197956471	-0.148777	0.197956471
Body Max Height	0.002833911	0.050013209	0.056663257	0.954968252	-0.096842271	0.102510093	-0.096842271	0.102510093
Eye Diameter	0.162652273	0.334842963	0.485756879	0.628594415	-0.504688791	0.829993337	-0.504688791	0.829993337
Mouth Height	0.104014408	0.073525608	1.41466913	0.161416924	-0.042521918	0.250550733	-0.042521918	0.250550733
Dorsal Fin length	-0.077310286	0.062406241	-1.238822991	0.219379653	-0.201685744	0.047065172	-0.201685744	0.047065172
Anal Fin Length	0.19726271	0.068688439	2.871847351	0.005338307	0.06036685	0.334158571	0.06036685	0.334158571
Pectoral Fin Length	0.292833945	0.146731275	1.995715937	0.049696383	0.000398935	0.585268955	0.000398935	0.585268955
Pelvic Fin Length	-0.65931473	0.224561634	-2.936007899	0.004443857	-1.10686542	-0.21176404	-1.10686542	-0.21176404
Tail fin Length	0.168760669	0.076016536	2.220052069	0.029520435	0.01725993	0.320261408	0.01725993	0.320261408
Head Height Behind Eye	0.030098521	0.112621198	0.267254494	0.790026814	-0.194355202	0.254552245	-0.194355202	0.254552245

The regression analysis shows that there is a strong correlation between morphometric traits and some factors of the environment. The multiple R-values of 0.999 give a perfect picture of correlation, and the R-squared value is almost 1, as close to 0.997, demonstrating 99.7% of the variation in the morphometric traits. Standard length ($\beta = 0.75$, $p < 0.01$) and post-dorsal fin length ($\beta = 0.18$, $p < 0.05$) are significant predictors that have a positive, strong relationship with body size. We also obtain highly negative coefficients associated with pelvic fin length ($\beta = -0.66$, $p < 0.01$) and a positive contribution from pectoral fin length ($\beta = 0.29$, $p < 0.05$). These results are in congruency with Maulana *et al.* (2019)[2], suggesting that environmental and nutritional factors play some roles in the morphometric development of aquatic species.

DISCUSSION

The studied morphometric characters of *Channa striata* from the Jumar River have explicit variations for the environment and supported the findings of Duong *et al.* (2019)[1], which discussed the variation between culture and wild population. Given the important positive relations between body size and fin length, the authors conclude that habitat conditions and environmental factors should have important impacts on these characters. The results support Roy *et al.* (2020)[10], who reported that both nutritional inputs regarding the quality of the diet provided and the environmental factors affect growth and morphometric changes. Such differences call for the implementation of accurate methods in the conservation and management of aquatic systems.

CONCLUSION

This study revealed high morphometric variations of *Channa striata* in the Jumar River based on regional and environmental factors. The outcomes of this study suggest that the body proportions and the fin sizes depend greatly on the environmental conditions, which confirms the role of habitat-based factors in fish morphology. These morphometric and environmental correlations suggest that the application of the standard fisheries management measures requires further complexity. These factors must be considered in order to effectively manage and conserve *Channa striata* and other fish species in aquatic environments. These results may be of some interest to other students of ecology and the habitat and to the actual application of habitat management and species protection.

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