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Morphometric Analysis of Native Freshwater Fishes from Manur Pond, Tirunelveli District, Tamil Nadu, India

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ABSTRACT
The present study aimed to conduct a morphometric analysis of native freshwater fish species, Glossogobius giuris and Mystus cavasius, collected from Manur Pond in Tirunelveli District, Tamil Nadu, India. The measurements of various morphometric characters were recorded, and the Gastro somatic Index was calculated to assess energy allocation and physiological condition within each species. The results revealed significant variations in the Gastro somatic Index values between the two species, with Glossogobius giuris exhibiting a wider range of values compared to Mystus cavasius, suggesting varying energy allocation strategies and physiological states among individuals. Furthermore, the physico-chemical analysis of Manur Pond's water parameters during February and March 2021 provided insights into the water quality and environmental conditions of the pond. The combined findings from this study contribute to a better understanding of the ecological dynamics and biological traits of the native freshwater fish species in Manur Pond, which is essential for informed management and conservation strategies to ensure the sustainability of the pond ecosystem's biodiversity and ecological balance.
Keyword: *Morphometric analysis, Gastro somatic Index, Native freshwater fish, Manur, pond ecosystem, water quality.*

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INTRODUCTION

Aquaculture is the farming of aquatic organisms, such as fish, crustaceans, mollusks, and aquatic plants (1). This ecosystem is normally associated with very low salinity, usually 15-30 ppt. They are highly variable, and their characteristics depend upon the surrounding geology, land use, and pollution levels (2). The term "pond ecosystem" refers to the freshwater ecology on which many creatures rely for both their survival and the provision of their nutritional requirements (2 & 3). A man-made or natural body of water is considered a pond. The water, minerals, dissolved oxygen, and carbon dioxide that make up a pond's ecology contain both biotic and abiotic elements (4). Morphometry is a crucial tool that provides a concept of the size and shape of specimens, which is important for their taxonomic identification (5 & 6). *Mystus cavasius* (Hamilton-Buchanan, 1822) is a catfish under the family Bagridae of the order Siluriformes. It is commonly known as *Gangetic Mystus*, which has been reported to be distributed in India, Bangladesh, Pakistan, Nepal, Sri Lanka, Thailand, and Myanmar (7). Recently, it has also gained popularity as an ornamental fish and has been exported from India at a good market price. The *Glossogobius giuris* or locally known as "Pijanga" and *Hypseleotris agilis* as "Bugwan" are considered significant fish supplies of the lake, but their richness has decreased significantly in the late 1990s. The dominance of these species in the lake ecosystem implies their suitability as good bioindicators for assessing the lake's condition. Manur Pond, a significant freshwater body located in Tirunelveli District, Tamil Nadu, India, holds considerable ecological importance, serves as an essential water source for the local community, and its geographical location in the southern Tirunelveli region adds to its significance within a diverse and ecologically rich area. The pond's ecosystem is home to a variety of native freshwater fish species, including *Glossogobius giuris* and *Mystus cavasius*, as observed in the conducted morphometric analysis. These fish species play a crucial role in the pond's ecological balance and are considered as bioindicators for assessing the pond's condition and environmental health. Manur Pond not only supports aquatic life but also contributes to the livelihoods of local communities who rely on it for various purposes, including fishing and agricultural irrigation. Therefore, effective management and conservation strategies are essential to ensure the long-term

sustainability of this valuable freshwater resource. There is no documentation on the study of morphometric relationships of native freshwater fish species from Manur Pond. Therefore, in the present investigation, morphometric relationships have been studied for *Mystus cavasius* and *Glossogobius giuris* collected from Manur Pond in Tirunelveli District, Tamil Nadu.

MATERIAL AND METHODS

Collection of Fish

Fish species were sampled from different locations in Manur Pond between December 2020 and March 2021. The fishes were captured using a pair of cost nets with a mesh size of 2 cm, stretched to 2.5 m in length and 2.5 m in radius. The collected fishes were then brought to the laboratory and preserved in 10% formalin solution in containers.

Identification of Fishes:

The freshwater fish specimens collected from Manur Pond were identified to species level using FishBase (8 & 9).

Collection of Water Sample

Water samples were collected using the bottle method, which is ideal for collecting samples from any desired depth of a shallow ecosystem. Polythene bottles with a capacity of 1 liter were used to collect water samples in February 2021, about 15 to 20 cm below the water surface. The total length of the fishes was measured from the tip of the end of the caudal fin, using a standard scale with a unit of 0.1 cm to 30 cm. The weight of all the fish was recorded using an electronic balance and measured to the nearest 100 gm (10 & 11).

Physico-Chemical Analysis:

The collected water samples were analyzed for various parameters including appearance, turbidity, color, odor, salinity, chlorinity, pH, dissolved oxygen, carbonate, and bicarbonate. The water samples were analyzed in the Zoology laboratory using standard methods. The sampling and analysis of physico-chemical attributes were conducted following the standard procedures as detailed in APHA (12). The experimental results were compared to the permissible limits of water quality index, considering nine important parameters (pH, TDS, DO, Na, K, Cl, TH, Ca, and Mg). To calculate this index, each parameter was assigned weights ranging from 1 to 5. The relative weight of each parameter is shown in Table 1.

Morphometric Characters:

The fish samples were used for the study of morphometric and length-weight relationship. Before measurement, fishes were properly wiped with blotting paper to remove moisture. The morphometric measurements and length-weight relationships were studied using the standard procedures detailed by (13 & 14). The morphometric characters of the fish, including Standard (LS), Orbital length (LO), Preorbital length (LPRO), Postorbital length (LPO), Pectoral fin length (LPTF), Pelvic fin length (LPVF), Eye orbit length (LOE), Dorsal fin length (LODF), Anal fin length (LAF), and Caudal fin length (LCF), were measured (in centimeters) using a standard scale.

- Standard (LS): Snout tip to midpoint of caudal fin origin.
- Orbital length (LO): Length (along the axis) of the orbit.
- Preorbital length (LPRO): Distance from the mouth tip to the anterior edge of the orbit.
- Postorbital length (LPO): Distance from the posterior edge of the orbit to the posterior edge of the operculum.
- Pectoral fin length (LPTF): Length of the fin from the dorso-posterior part of the fin base to the distal edge of the fin.
- Pelvic fin length (LPVF): Length from the point of insertion of the fin to the tip of the longest fin.
- Eye orbit length (LOE): Diameter of the eye measured from the anterior to the posterior of the eyeball.
- Dorsal fin length (LODF): Distance from the anterior most tip of the dorsal fin to the base tip of the dorsal fin.
- Anal fin length (LAF): Distance from the base to the tip of the anal fin.
- Caudal fin length (LCF): Distance from the base of the body where the caudal fin starts to the tip of the caudal fin.

Data Analysis:

The range and mean ± standard deviation was calculated for each morphometric measurement for the four groups: female *G. giuris*, male *G. giuris*, female *M. cavasius*, and male *M. cavasius*. This allowed comparison of size variation within and between species and sexes. All statistical analyses were performed using SPSS version 16.0 software (15).

RESULTS AND DISCUSSION

Two native freshwater fish species, *Mystus cavasius* and *Glossogobius giuris*, were collected from Manur Pond in Tirunelveli for this study. Morphometric measurements of the sampled fish are presented in Table 1. The measurements include total length, standard length, pectoral fin length, pelvic fin length, eye orbit, pre-orbit, post-orbit, dorsal fin length, anal fin length, caudal fin length, and total weight. For each species and sex category (*G. giuris* females, *G. giuris* males, *M. cavasius* males, *M. cavasius* females), the range and mean ± standard deviation is provided for each morphometric characteristic. This allows comparison of size variation within and between the species and sexes sampled from Manur Pond. The total and standard-length ranges for female *G. giuris* (n=14) were 6.5-7.5cm (mean 7±0.707cm) and 4.8-6cm (mean 5.4±0.848cm) respectively. For male *G. giuris* (n=18), total and standard lengths ranged from 11-14.5cm (mean 12.75±2.474cm) and 7-12cm (mean 9.5±3.535cm). Male *M. cavasius* (n=15) showed total and standard-length ranges of 10.3-12cm (mean 11.5±1.202cm) and 8.5-10.5cm (mean 9.5±1.414cm). In female *M. cavasius* (n=15), total and standard-length ranges were 5-9.5cm (mean 7.25±3.181cm) and 4.2-7.5cm (mean 5.85±2.333cm). Lengths were measured in cm. Standard deviation values indicate variability in measurements within each group. Muthukrishnan *et al*., (16) studied the morphometric measurements and meristic counts of 22 specimens of *Mystus gulio* catfish from the Maruthur wetland in Tirunelveli District, Tamil Nadu, and India. They examined 28 different morphometric characters expressed as percentages of total fish length and head length. The morphometric features analyzed included measurements like body depth, head length, snout length, interorbital distance, dorsal fin lengths, pectoral fin length, pelvic fin length, anal fin length, caudal fin length, etc. Their study provided a detailed analysis of the morphometrics of *M. gulio* from the Maruthur wetland population. Archana Lalwani *et al*., (17) analyzed various morphometric measurements of *Mystus seenghala*. These included eye diameter (0.5-1.4 cm), head length (3-6.5 cm), standard length (10.5-31 cm), body depth (2-4.5 cm), total length (16-38 cm), pre-pectoral length (3-7 cm), pre-dorsal length (5-9 cm), pre-adipose length (7-22 cm), pre-pelvic length (6.3-14.7 cm), and pre-anal length (10-24 cm). The total length ranged from 1.5-1.22 times the standard length, and 5.34-5.84 times the head length. Total length was also 5.34-5.42 times the pectoral length, 8-8.83 times the body depth, 3.2-4.2 times the pre-dorsal length, 2.28-1.72 times the pre-adipose length, 1.6-1.58 times the pre-anal length, and 2.53-3.58 times the pre-pelvic length. The comprehensive morphometric analysis provides insights into body shape and size relationships in *M. seenghala.* Veerpal Kaur *et al*., (18) examined the morphometric characteristics of *Labeo rohita* collected monthly from a pond near Kalayat, Kaithal, Haryana, India. Eighteen morphometric measurements were expressed as percentages of total fish length, revealing 13 genetically controlled characters, 3 intermediate characters, and 2 environmentally influenced characters. Of the measurements expressed as percentages of head length, 5 were genetically controlled and 1 was intermediate. Overall, a positive correlation was observed between total body length and external body part dimensions in *L. rohita*. The study provides insights into the genetic versus environmental determinants of morphological variation in this fish species based on detailed morphometric analysis. Aisyah and Syarif (19) examined 12 morphometric features of the Selangat fish (Anodontostoma sp.) from Kelabat Bay and Tukak Strait, Bangka Belitung. Some of the common morphometric measurements they analyzed included total length, standard length, head width, head depth, snout length, interorbital distance, pre-anal length, body depth, caudal peduncle length, dorsal fin base length, pre-pectoral length, and minimum caudal fin length. Their study compared these morphometric characters between Selangat fish populations from the two locations. Water quality is a crucial factor in determining the suitability of water resources for drinking, domestic use, and irrigation. The chemical composition and concentrations of various constituents influence surface water (ponds) and groundwater quality. Evaluating water quality by analyzing its chemical parameters is therefore important to assess its potability and utility for human needs. The concentrations of different chemical components in water can serve as indicators of overall water quality (20). Table 2 presents the physicochemical parameters recorded in Manur Pond in February and March 2021, including water temperature, transparency, dissolved oxygen, turbidity, total dissolved solids, salinity, chlorinity, and pH. Water temperature was 30°C in February and 31°C in March. Transparency remained stable at 6.0 cm. Dissolved oxygen was 5.40 and 5.45 mg/l in February and March, respectively. Turbidity, total dissolved solids, salinity, chlorinity, and pH showed minor fluctuations between the two months. These measurements provide insights into water quality and environmental conditions in Manur Pond during this timeframe. Seetha and Chandran (21) analyzed various water quality parameters in three ponds located in Vellore district, Tamil Nadu, India. The parameters measured included temperature, pH, dissolved oxygen, alkalinity, electrical conductivity, chloride, sulfate, nitrate, calcium, and chloride. In a more recent study, Anbu Radhika (22) examined physicochemical characteristics of water samples from two ponds, Sankarankovil Oorkulam and Seevalarayanendhal, in Tenkasi district, Tamil Nadu. The parameters analyzed were appearance, color, odor, turbidity, total solids, electrical conductivity, pH, alkalinity, hardness, sodium, potassium, iron,

manganese, ammonia, nitrate, nitrite, chloride, fluoride, sulfate and phosphate. Levels of free CO2, alkalinity, phosphate phosphorus, nitrate-nitrogen and chemical oxygen demand were found to be highest in Seevalarayanendhal Pond compared to Sankarankovil Oorkulam Pond. Sinha Deepak (20) analyzed the physicochemical characteristics of water samples from nine prominent ponds located in Bemetara town, Chhattisgarh state, India. The study was conducted over three seasons - summer, rainy, and winter. The parameters measured included temperature, color, turbidity, pH, electrical conductivity, total alkalinity, chloride, total hardness, calcium, magnesium, total dissolved solids, fluoride, sulfate, nitrate, dissolved oxygen, and biochemical oxygen demand (BOD).

Comparing the results from Table 3 and Table 4, it is evident that there are differences in the Gastro somatic Index values between the two native freshwater fish species, *Glossogobius giuris* and *Mystus cavasius*. For *Glossogobius giuris*, the Gastro somatic Index values range from 0.72 to 2.2, with Intestine Length ranging from 5.4 cm to 8 cm and Intestine Weight ranging from 4.2 grams to 6.60 grams. The Liver Weight varies from 0.5 gm to 1.6 gm. This indicates a notable variation in the Gastro somatic Index values within this species, reflecting possible differences in the energy allocation and physiological condition among individuals. On the other hand, for *Mystus cavasius*, the Gastrosomatic Index values range from 1.1 to 1.9, with Intestine Length varying from 3 cm to 5.9 cm and Intestine Weight ranging from 2.8 grams to 4.8 grams. The Liver Weight falls within the range of 0.21 gm to 0.55 gm. In comparison to *Glossogobius giuris*, *Mystus cavasius* exhibits a narrower range of Gastrosomatic Index values, suggesting a more consistent energy allocation pattern or physiological state among individuals within this species. Overall, the Gastrosomatic Index measurements in both fish species provide valuable insights into their physiological traits and energy allocation strategies. These findings are important for understanding the ecology and biology of *Glossogobius giuris* and *Mystus cavasius* in their respective freshwater habitats.

Table.1 Morphometric measurements of selected fish species from Manur Pond (Range, Mean±S.D)

Morphometric characters	***Glossogobius giuris* (♀ n=14)**		***Glossogobius giuris* (♂ n=18)**		***Mystus cavasius* (♂ n=15)**		***Mystus cavasius* (♀ n=15)**	
	Range	**Mean± SD**	**Range**	**Mean± SD**	**Range**	**Mean±SD**	**Range**	**Mean± SD**
Total length	6.5-7.5	7± 0.707	11- 14.5	12.75±2.474	10.3-12	11.5±1.202	5-9.5	7.25±3.181
standard length	4.8-6	5.4± 0.848	7- 12	9.5±3.535	8.5-10.5	9.5±1.414	4.2-7.5	5.85±2.333
Pectoral fin	5.1-6	5.55± 0.636	1.2- 1.6	1.4± 0.282	0.6-1.1	0.85±0.353	4.8-6.9	5.85±1.485
pelvic fin	0.3-0.4	0.35± 0.071	0.4- 0.9	0.65±0.353	0.3-0.5	0.4±0.141	0.2-0.8	0.5±0.424
Eye orbit	0.2-0.3	0.25± 0.070	0.3- 0.7	0.5 ± 0.282	0.2-0.4	0.3±0.141	0.2-0.3	0.25±0.071
Pre orbit	0.1-0.2	0.15± 0.072	2.6- 4.5	3.55±1.343	2.4-2.9	2.65±0.353	0.1-0.2	0.15±0.071
Post orbit	1.7-1.8	1.75± 0.072	1.7- 3.1	2.4±0.989	1.3-1.9	1.6±0.424	1.3-2.1	1.7±0.566
Dorsal fin length	0.4-0.5	0.45± 0.071	0.7- 2	1.35±0.919	0.7-1	0.85±0.212	0.3-0.7	0.5±0.283
Anal fin length	0.5-0.6	0.55± 0.077	2.1- 2.9	2.5±0.565	1-2.5	1.75±1.061	0.4-0.9	0.65±0.353
Caudal fin	1.1-1.6	1.35± 0.353	2- 2.9	2.45±0.636	2.1-2.9	2.5±0.566	0.8-1.8	1.3± 0.707
Total weight	9.1-11	10.1± 1.343	11.1- 30.7	20.9±13.85	10.9-13.8	12.35±2.051	8.1-20	14.05±8.414

(Length in (cm), Weight in (g), S.D= Standard Deviation

Table. 2 Physico-chemical parameters of Manur pond (February to March 2021)

Physic-Chemical Parameters	**Values (February)**	**Values (March)**
Water temparature	30^{0C}	31^{0C}
Water transparency	6.0 cm	6.0
Dissolved oxygen (Do)	5.40mg /l	5.45mg/l
Turbidity	0.4 NTU	0.5 mg/l
Total dissolved solid (TDS)	0.1g/l	0.2g/l
Salinity	0.481ppm	0.462
Chlorinity	o.774ppm	0.785
pH	7.2	7.1

Table. 3 Gastrosomatic Index of native fresh water fish *Glossogobius giuris*

Intestine Length (cm)	6.2	5.7	7.5	5.4	6.5	6.9	7.1	6.9	6.8	8
Intestine Weight (gm)	5.4	4.8	6.2	4.2	5.6	5.9	6	5.9	5.8	6.60
Liver Weight (gm)	0.78 =1.6	0.5 =2.1	1.0 =2.2	0.6 =1.9	0.5 =2.2	0.6 =1.9	0.98 =2.1	0.78 =2.0	0.72 =1.9	1.6 =1.9

Table.4 Gastrosomatic Index of native fresh water fish *Mystus cavasius*

Intestine Length (cm)	4.2	4.6	3.1	4.1	3	5.1	3.5	5.9	3.1
Intestine Weight (gm)	3.8	4.7	2.8	3.1	2.9	4.7	3.1	4.8	2.9
Liver Weight (gm)	0.27 =1.9	0.3 =1.5	0.21 =1.4	0.35 =1.4	0.55 =1.5	0.35 =1.6	0.5 =1.2	0.4 =1.3	0.3 =1.1

CONCLUSION

The morphometric and Gastroscopic Index analyses provide quantitative evidence of morphological and physiological distinctions between *G. giuris* and *M. cavasius* inhabiting Manur Pond. The findings offer valuable biological insights into these native freshwater fishes and lay the groundwork for future studies elucidating their evolutionary ecology within this significant aquatic ecosystem.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable

CONFLICTS OF INTEREST

The authors reveal no conflicts of interest concerning the work reported in this article.

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