Research Article

A Study of Length Weight Relationship and Feeding Habit in Two Threatened Fish Species *Glossogobius giuris* and *Nandus nandus* from Sessa River, Dibrugarh, Assam, North-East India

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ABSTRACT

The present study illustrates the inclusive information of morphological relationships, including morphometric parameters, meristic count, length-length relationships (LLRs), length-weight relationship (LWRs) and feeding biology of two threatened freshwater fish species, *Glossogobius giuris* and *Nandus nandus* from Sessa River, Dibrugarh, Assam. All the morphometric parameters revealed a proportional change with the increase in total length of the fish species. The growth coefficient 'b' in the LWR for both the fish species *G. giuris* and *N. nandus* exhibited values <3 which shows a negative allometric growth. The coefficient of correlation (r) was recorded 0.97 in *G. giuris* and 0.95 in *N. nandus* which showed high degree of correlation in the species. The relative condition factor (K) fluctuated between 1.79 and 1.97 respectively, indicating a state of well-being for these fish species. The degree of association between the variables was computed by the determination coefficient, R^2. The body lengths were found highly significant with all "*r*" values being >0.900 and positively correlated with TL. The value of RLG for both the species was <1 which indicates the carnivorous nature of the fishes.

Keywords: Morphological parameters, LWR, K factor, R.L.G., *Glossogobius giuris, Nandus nandus,* Assam.

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INTRODUCTION

The north-eastern part of India is endowed with rich wealth of aquatic fauna which harbour diverse varieties of food, ornamental and medicinally important fishes. *Glossogobius giuris* and *Nandus nandus* are among the two threatened freshwater fish species under the family Gobiidae and Nandidae respectively.[1,2] These fishes are featured with array of morphological, physiological and behavioural adaptation in their respective habitats. Besides these fishes needs to be fed in a particular way and according to their morphological variations.[3]

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The studies on morphometric and meristic features are constructive tools for exacting identification of any species and its classification.[4,5] In fisheries research, appraising the well-being of individuals as well as evaluating the life history, the morphological traits of populations of different locality greatly rely on morphometric characters.[6,7] Besides, the length-weight relationship is an important aspect in the study of fish biology. Mathematical expression between length-length and length- weight helps to measure the variation between the expected and observed length or weight for a length of individual fish as an indication of growth, general well-being, and rate of feeding, metamorphosis and maturity.[8] Seasonal length-length and length-weight monitoring helps in calculating the growth rate in a particular water body and facilitate in adopting corrective measures in aquaculture programme. Most studies on food and feeding habits of

fishes under varying ecological conditions have shown that those species differ in time in different stages of growth.[9] A few studies, including morphometric and meristic characters, Length-Length Relationships (LLRs), Length-Weight Relationships (LWRs), food and feeding habits, have been conducted on these species from other habitats.[4] However, no detail study hitherto been conducted from the Sessa River. Therefore, the present study is designed to investigate certain aspects of biology of *Glossogobius giuris* and *Nandus nandus* from R. Sessa of Upper Assam.

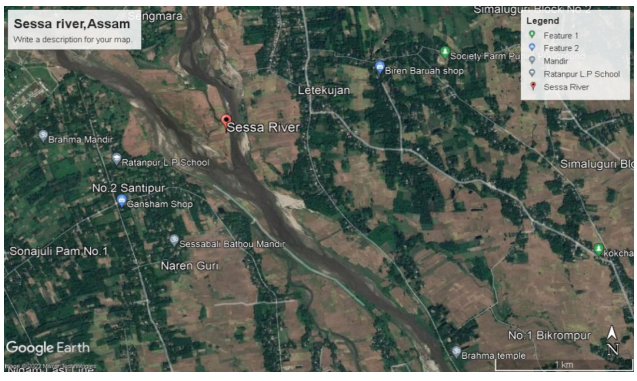
MATERIALS AND METHODS

The materials of the present study pertain to the 162 specimens of *Glossogobius giuris* and *Nandus nandus*, collected from Sessa River in Dibrugarh district of Assam from January 2017 to June 2018.

After collection, samples were preserved in 10% formalin and various morphological characteristics were examined following Talwar and Jhingran,[5] Keat-Chuan et al.[10] and Rainboth.[11] Species identification was based on taxonomic keys by Talwar and Jhingran[5] and Ambak *et al*.[12] Each individual fish was weighed and taken measurements (using calipers, accuracy 0.1 mm) of body lengths, fin lengths, distance from the mouth to fins (or distance before fins), caudal fin length and height, and head morphometric. A total of 22 morphometric parameters and five meristic characters have been undertaken according to Lowe Mc Connell.[13] All the measurements and counts were made on the left side of the fish.

The relationship between length-length (LLRs) and length-weight (LWR) of the fish samples were calculated using the equation $W = aL^b$. The values of constant a and b were estimated using the least-square method applied to the log transformed data as log W= log a + b log L,[14] where W (g) is the body weight of the fish, L (cm) is the total length, 'a' is the intercept of the regression curve and 'b' is the regression coefficient. Fulton's condition factor (K) was estimated from the relationship $K=100W/L^3$.

The individual fish was cut open and gut was removed and weighted for calculating the Gastro- somatic index (GSI) using the formula GSI (%) = Weight of gut (g) / Weight of fish (g) X 100.[15] Relative length of gut (RLG) was also calculated as per the formula- RLG = Length of gut / total length of fish. [15]



Geographical location of study site, Sessa River.

Studied fish species (a) *G. giuris* (b) *N. nandus*.

RESULTS

The present study illustrates the inclusive information of morphological relationships, including morphometric parameters, meristic count, length-length relationships (LLRs), length-weight relationship (LWRs) and feeding biology of two threatened freshwater fish species *G. giuris* and *N. nandus* from Sessa River, Dibrugarh, Assam. The morphometric parameters and meristic counts of the fish species are given in Table 1 and Table 2 respectively. All the parameters in terms of LLRs exhibit a proportional increase (Table 3) to the total length of the fish species. The descriptive statistics of LWRs, 'a' and 'b' with their 95% of confidence limits, coefficient of correlation (r), coefficient of determination (R^2) and Fulton's condition factor (K) have been represented in Table 4. In *G. giuris*, total lengths (TL) were recorded in the range of 3.6 to 12.9 cm with a weight range of 1.65 to 54.85 g and in *N. nandus* the TL ranged between 4.8 to 15.7 cm and weight ranged from 3.55 to 77.49 g. The value of exponent 'b' was also found within the range of 2.75 to 2.91 (Table 4). Highest 'b' value was recorded in *N. nandus* (2.91) and lowest in *G. giuris* (2.75). The r-value for the investigated species were recorded 0.97 in *G. giuris* and 0.95 *N. nandus*. Similarly, coefficient of determination, R^2, was varied from 0.85 in *G. giuris* and 0.83 in *N. nandus*. Mean K-factor was observed with a range from 1.79 in *G. giuris* and 1.97 in *N. nandus*. Estimated morphological parameters related to feeding biology with seasonal variation are represented in Table 5. The value of GSI for both the species was recorded maximum in pre monsoon (*G. giuris* = 8.14 and *N. nandus* = 5.00) and lowest in monsoon (*G. giuris* = 1.52 and *N. nandus* = 2.11). In this investigation, analysis on all the morphological parameters including

Table 1: Morphometric characters of *G. giuris* and *N. nandus*.

Morphometric parameters	*G. giuris* mean ± s.d	*N. nandus* mean ± s.d
Total length	9.90 ± 2.43	9.65 ± 2.30
Standard length	8.10 ± 0.39	8.00 ± 1.10
Body depth	1.60 ± 0.07	3.10 ± 0.43
First dorsal fin length	1.30 ± 0.15	0.9 ± 0.12
Second dorsal fin length	2.10 ± 0.20	-
First dorsal fin base	1.00 ± 0.10	4.10 ± 0.58
Second dorsal fin base	1.00 ± 0.10	-
Pectoral fin length	1.80 ± 0.18	1.90 ± 0.26
Pectoral fin base	0.75 ± 0.10	0.75 ± 1.00
Pelvic fin length	1.65 ± 0.17	1.15 ± 0.16
Pelvic fin base	1.05 ± 0.14	0.60 ± 0.80
Anal fin length	1.20 ± 0.14	1.15 ± 0.17
Anal fin base	1.70 ± 0.17	1.20 ± 0.17
Length of caudal peduncle	0.80 ± 0.14	1.10 ± 0.14
Least height of caudal peduncle	1.70 ± 0.17	1.66 ± 0.22
Head length	2.45 ± 0.20	3.05 ± 0.43
Pre-orbital length	0.85 ± 0.10	0.95 ± 0.13
Post-orbital length	1.20 ± 0.14	1.65 ± 0.23
Eye diameter	0.35 ± 0.04	0.65 ± 0.09
Head depth	1.05 ± 0.14	0.90 ± 0.13
Mouth gape	1.15 ± 0.14	1.40 ± 0.19

Table 2: Meristic counts of *G.giuris* and *N. nandus*.

Parameters	Spines		Soft rays	
	G.giuris	*N. nandus*	*G. giuris*	*N. nandus*
1st Dorsal fin rays	-	13	7	11
2nd Dorsal fin rays	-	-	11	-
Pectoral fin rays	-	1	18	14
Pelvic fin rays	-	-	10	5
Anal fin rays	1	3	8	7
Caudal fin rays	-	-	20	14

Table 3: Regression equation of Length Length relationship in *G. giuris* and *N. nandus*.

Parameters	Regression equation		Corelation coefficient (r)	
	G. giuris	*N. nandus*	*G. giuris*	*N. nandus*
Standard length (X) on Total length(Y)	Y = 0.36+ 1.40 X	Y = 0.49+ 1.09X	1.23	0.99
Head length (X) on Total length (Y)	Y = 0.39+ 3.12X	Y = -3+ 2.03X	0.99	0.99
Body depth(X) on Total length(Y)	Y = 0.15 + 1.8X	Y = 2.69 + 2.0X	0.89	1.00
Eye diameter(Y) on Head length(X)	Y = -0.25 + 2.5X	Y= -2.18 + 0.40X	0.98	1.03

Table 4: Length weight relationship and condition factor.

Family/Species	N	L_{min}-L_{max}	W_{min}-W_{max}	a^a	95% CL of a^a	b	95% CL of b	r	R^2	K
Gobiidae/G. giuris	67	3.6-12.9	1.65-54.82	0.07	0.011-0.057	2.91	2.50-3.46	0.97	0.85	1.79
Nandidae/N. nandus	95	4.8-15.7	3.55-77.49	0.13	0.104-0.221	2.75	2.06-2.96	0.95	0.83	1.97

N: sample size, L: length (cm), W: weight (g), min: minimum, max: maximum, a: intercept, a- anti-log a, CL: confidence of limits, b: slope, r: coefficient of correlation, R_2: coefficient of determination, K: condition factor

Table 5: Nature of intestine, feeding intensity and feeding habit.

Seasons	Fullness of gut		Nature of intestine		RLG		GSI	
	G. giuris	N. nandus	G. giuris	N. nandus	G. giuris	N. nandus	G. giuris	N. nandus
Pre monsoon	Full	Full	Single coiled	Single coiled	0.60 ± 0.11	0.81 ± 0.07	8.14 ± 1.0	5.00 ± 0.97
Monsoon	Empty	Empty	Straight	Straight	0.78 ± 0.10	0.70 ± 0.12	1.52 ± 0.21	2.11 ± 0.68
Post monsoon	½ to ¾	¾ to ¼	Straight	Straight	0.45 ± 0.2	0.97 ± 0.11	4.42 ± 0.85	3.68 ± 0.59

LWRs for all the fish species were found to be statically significant (p<0.005)

DISCUSSION

Morphological characters in fishes change in response to different environmental conditions such as food abundance and temperature. Besides, it serves as an important tool for fish identification and their general well-being.[16,17] The relationship between fish body length and weight has a significant role in fisheries biology and population dynamics where stock assessment models require the use of length-weight parameters.[18] Generally, length and weight are

correlated as fish growth increases with increases in body length. Besides, the length-weight relationships of fishes are influenced by many factors such as the length range of specimens sampled, numbers, habitats, seasonality, sex, diet, and stomach fullness.[18,19] LWRs are also used to provide information on the fish health condition and to determine whether growth is isometric (b=3) or allometric (negative allometric: b<3) r positive allometric: b>3).[14,20] The present study shows a negative allometric growth pattern in both the species as the exponential value 'b was recorded <3. Similar result was also observed by Hossain *et al*.[21] Islam *et al*.[22] Hossain *et al*.[6] while dissimilar result in *G. giuris* (b= 3.07-3.09) was observed by Hossain *et al*.[23] In addition, all LLRs were highly correlated, which is not in accordance with Hossain *et al*.[23,24] This differences in the current study compared to other studies could root from spatial and temporal variations caused by local differences in environmental conditions such as temperature, habitat type, and differences in fish behavior in different habitats.[25] The degree of association between the variables was computed by the determination coefficient, R^2. The body lengths were found highly significant with all "r" values being >0.900 and positively correlated with TL. The obtained regression equations clearly revealed that the lengths of the body parts are proportional to the total length. Such finding were also observed by Tandon *et al*.[26] while working with the morphometry of *Cirrhinus reba* and *Puntius sophore*.[27] Statistics on food and feeding habits of fishes is very much essential in understanding fish biology and their management.[26-28] For successful fish farming, a thorough knowledge about the food and feeding habit of the fish species under interest is necessary.[29,30] Considering the information documented in this study, it is quite clear that no such contradictory information is available on its feeding habit as all the earlier researchers have reported the carnivorous nature of the studied fish species.

CONCLUSION

The data generated in the present study provides the fundamental information of length-length relationships, length-weight relationships, morphometric and meristic character. Based on the current study, it was concluded that the length-weight relationship indicated negative allometric growth according to the cube law, which indicated that the present conditions in Sessa River were not ideal for the optimum growth this fish. These findings would be a helpful tool for the fishery managers/biologists to access the ecological status and growth of the fish population to instigate the stock assessment and conservation of the threatened freshwater fish species.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

LLRs: Length-length relationships; **LWR:** Length-weight relationship; **RLG:** Relative lengths of gut; **TL:** Total length; **SL:** Standard length; **CL:** Confidence of limits; **R&D:** Research and Development.

SUMMARY

Fishes are very sensitive to the environments and adapt accordingly to any changes in them with necessary morphometric changes. Length-length relationship, Length-weight relationship and condition factor are considered to be the fundamental tools in study of fish biology and fisheries management as it provides key information regarding fish growth, health, population dynamics and stock condition. In general, the body length proportionally changes with the increase in total length and weight and shows a linear growth fashion. However, both the species exhibited a negative allometric pattern of growth. Even though the change of b values in the length-weight relationship depends primarily on the shape and fatness of the fish species. it is affected by many various factors as such seasons, temperature, salinity, food (quantity, quality and size), sex and stage of maturity. The statistical significance level of R^2 and 95% confidence limits of the parameters a and b were estimated and showed linear growth at $p<0.05$. The results obtained from this study are useful to fisheries scientist. In summary, this study updates length-weight parameters for many species encountered by fresh water fish species. This investigation will play important role for the management and conservation of these species as well as other small indigenous fish species.

REFERENCES

1. Gupta S. Biology of Gangetic Leaf Fish, Nandus nandus (Hamilton, 1822): a Review. J Biodivers Endanger Species;s2. doi: 10.4172/2332-2543.S2-003.
2. Azad MAK, Hossain MY, Khatun D, Parvin MF, Nawer F, Rahman O, et al. Morphometric relationships of the tank goby *Glossogobius giuris* (Hamilton,

1822) in the Gorai River using multi-linear dimensions. Jordan J Biol Sci. 2018;11(1):81-5.
3. Islam MA, Hossain MY, Rahman MA, Rahman O, Sarmin MS, Khatun D, et al. Some biological aspects of Asian stinging catfish, *Heteropneustes fossilis* (Bloch, 1794) (Teleostei: Siluriformes) in a wetland ecosystem. Iran J Ichthyol. 2021;8(1):52-61.
4. Hossain MS, Roy A, Rahman ML. Food and feeding habit of Bele *Glossogobius giuris* (Hamilton and Buchanan, 1822) collected from Mithamain Haor of Kishoreganj districts, northeastern Bangladesh. Int J Fish Aquat Stud. 2016;4:84-8.
5. Talwar PK, Jhingran AG. Inland fisheries of India and adjacent countries. New Delhi. Oxford: IBH Publishing Co, Pvt, Ltd.; 1991. p. 1-158.
6. Hossain MS, Sultana N. Morphometric characters and length- weight relationship of Bele, (*Glossogobius giuris*) from Mithamoin Hair, Kissorgonj, Bangladesh. Bangladesh Agril Univ. 2014;12:389-95.
7. Hossain MY, Hossen MA, Ahmed ZF, Hossain MA, Pramanik MNU, Nawer F, et al. Length–weight relationships of 12 indigenous fish species in the Gajner Beel floodplain (NW Bangladesh). J Appl Ichthyol. 2017;33(4):842-5. doi: 10.1111/jai.13354.
8. Le Cren ED. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). J Anim Ecol. 1951;20:201-19.
9. De Silva SS. Food and feeding habits of the herring *Clupea harengus* and the sprat *C. Sprattus* in inshore waters of the west coast of Scotland. Mar Biol. 1973;20(4):282-90.
10. Ng K-C. C, Aun-Chuan Ooi P, Wong WL, Khoo G. A review of fish taxonomy conventions and species identification techniques. J Surv Fish Sci. 2017;4(1):54-93.
11. Rainboth WJ. Fishes of the Cambodian Mekong. United Nations, Rome. Food and Agriculture Organization; 1996.
12. Ambak MA, Zakaria MZ. Freshwater fish diversity in Sungai Kelantan. J Sustain Sci Manag. 2010;5(1):13-20.
13. Lowe-McConnell RH. The fishes of the Rupununi savanna district of British Guiana, South America. J Linn Soc Lond (Zool).1964;45:103-144.
14. Ricker WE. Linear Regressions in Fishery Research. J Fish Res Bd Can. 1973;30(3):409-34. doi: 10.1139/f73-072.
15. Biswas SP. Manual of methods in fish biology. Delhi: South Asian Publishers; 1993.
16. Sidiq M, Ahmed I, Bakhtiyar Y. Length-weight relationship, morphometric characters, and meristic counts of the coldwater fish (Heckel) from Dal Lake. Fish Aquat Sci. 2021;29(1):29-34.
17. Wimberger PH. Plasticity of fish body shape. The effects of diet, development, family and age in two species of Geophagus (Pisces: Cichlidae). Biol J Linn Soc. 1992;45(3):197-21.
18. Froese R. Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. J Appl Ichthyol. 2006;22:241-53.
19. Sharma NK, Mir JI, Singh R, Akhtar MS, Pandey NN. Length-weight relationships for eight fish species from the Ravi River, north-western India. J Appl Ichthyol. 2015;31:1146-7.
20. Spiegel MR. Theorite et applications de la statistique. New York: McGraw-Hill; 1991. p. 358.
21. Hossain MY, Hossen MA, Khairun Y, Bahkali AH, Elgorban AM. Length-weight relationships of *Dermogenys pusilla* and *Labeo bata* (Cyprinidae) in the Ganges River (NW Bangladesh). J Appl Ichthyol. 2016a;32:744-6.
22. Islam MS, Tuly DM, Hasnahena M, Bahadur P, Hasan MR. Induced breeding of freshwater Goby, *Glossogobius giuris* (Hamilton, 1822) in the Captivity: A preliminary Study. J Fish Aquat Sci. 2013;9(1):24-32. doi: 10.3923/jfas.2014.24.32.
23. Hossain MY, Jasmine S, Ibrahim AHM, Ahmed ZF, Rahman MM, Ohtomi J. Length-weight and length–length relationships of 10 small fish species from the Ganges, Bangladesh. J Appl Ichthyol. 2009;25:117-9.
24. Hossain MY, Hossen MA, Khatun D, Nawer F, Parvin MF, Rahman O et al. Growth, condition, maturity and mortality of the Gangetic Leaf fish *Nandus nandus* (Hamilton, 1822) in the Ganges River (Northwestern Bangladesh). Jordan J Biol Sci. 2017;10:57-62.
25. Al Nahdi A, Garcia de Leaniz C, King AJ. Spatio-temporal variation in length-weight relationships and condition of the ribbonfish *Trichiurus lepturus* (Linnaeus, 1758): implications for fisheries management. PLOS ONE. 2016;11(8):e0161989. doi: 10.1371/journal.pone.0161989, PMID 27579485.
26. Tandon KK, Johal MS, Bala S. Morphometry of *Cirrhinus reba* (Hamilton) from Kanjli wetland, Punjab, India. Res Bull Punjab Univ Sci. 1993;43(1-4): 73-8.
27. Begum M, Alam MJ, Islam MA, Pal HK. On the food and feeding habit of an estuarine catfish (*Mystus gulio* Hamilton) in the south-west coast of Bangladesh. Univ J Zool Rajshahi Univ. 2008;27:91-4. doi: 10.3329/ujzru.v27i0.1962.
28. Bhuiyan AS, Afroz S, Zaman T. Food and feeding habit of the juvenile and adult snakehead, *Channa punctatus* (Bloch). J Life Earth Sci. 2006;1:53-4.
29. Hossain MY, Rahman MM, Abdallah EM. Relationships between body size, weight, condition and fecundity of the threatened fish *Puntius ticto* (Hamilton 1822) in the Ganges River northwestern Bangladesh. Sains Malays. 2012;41(7):803-14.
30. Santos MN, Gaspar MB, Vasconcelos P, Monteiro CC. Weight–length relationships for 50 selected fish species of the Algarve coast (southern Portugal). Fish Res. 2002;59(1-2):289-95.

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