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Original Article

Length-length and length-weight relationships and condition factor of nine freshwater fish species of Nageshwari, Bangladesh

Most Habiba Ferdaushy, Mohammad Manjurul Alam*

Department of fisheries, University of Rajshahi, Rajshahi-6205, Bangladesh.

Abstract: The research carried out the length-length relationships (LLR), length-weight relationship (LWR) and condition factor of nine freshwater small indigenous species viz. *G. giuris*, *E. Danricus*, *M. pancalus*, *L. guntea*, *C. fasciatus*, *P. sophore*, *H. Fossilis*, *C. punctatus* and *M. cavasius* from the water bodies of Nageshwari, Bangladesh. Relationships among different body length parameters of each species were found highly significant with all "r" values being >0.900. LWRs were obtained on the form of $TW = \alpha TL^b$. The "*b*" values range from 2.65-3.03. The parameter "*b*" of the length-weight relationship equation showed higher value (>3) only for *G. giuris* and *C. fasciatus*. Rest of the specimens showed lower value (<3) but close to the value of 3 and relationships were found highly significant with all "r" values being >9.00. The Fulton's condition factors showed positive growth tendency for five specimens *viz. G. giuris*, *C. fasciatus*, *P. sophore*, *C. punctatus*, *M. cavasius*; and negative tendency for four specimens *viz. E. danricus*, *M. pancalus*, *L. guntea*, and *H. Fossilis*.

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Introduction

Morphometric measurements and statistical relationships of fishes are imperative for both fishery biology (Sparre et al., 1989; Mustafa and Brooks, 2008) and taxonomic studies (Tandon et al., 1993; Simon et al., 2010; Alam et al., 2014). The application of length-weight relationship in fishery biology solves various problems concerned with the life history of fishes. Length-weight relationship also gives information about the condition and growth patterns of fish (Bagenal and Tesch, 1978; Oscoz et al., 2005; Alam et al., 2014). In addition, condition factors may be used to detect seasonal variations in the growth of fish, which may vary with food abundance and average reproductive stage of the stock (King, 1995; Alam et al., 2014). For proper management and conservation of the wild population of fish species, morphometric study is necessary. In Bangladesh, a total of 260 indigenous freshwater fish species were reported (Rahman, 2005) of which small indigenous fishes species are important target species for the small-scale fishermen (Criag et al., 2004; Mustofa and Brooks, 2008); and serve as a major source of protein and vitamin for the rural community (Rubbi et al., 1978).

The present study aimed to find out the present status of length-length and length-weight relationship; and condition factor of nine fish species *viz. Glossogobius giuris*, *Esomus danricus*, *Mastacembelus pancalus*, *Lepidocephalus guntea*, *Colisa faciatus*, *Puntius sophore*, *Heteropneustes fossilis*, *Channa punctatus*, and *Mystus cavasius*. Findings of the work will play an important role for the successful management of these species to conserve from probable depletion of their wild stock in the future.

Materials and Methods

The specimens were collected fortnightly from the fishers of Nageshwari (25.9792°N 89.7083°E) water

* Corresponding author: Mohammad Manjurul Alam
E-mail address: mamillat@yahoo.com

bodies during day time from October, 2011 to January, 2012. During the period a total of 540 specimens (each of 60) were collected and confirmed to the species level and preserved by date in plastic jars with 5% formalin. For each individual different body lengths TL, PL, PVL, SL, HL, DL, AL were measured with the help of a digital slide caliper and whole body weight (TW) was taken with the help of a digital balance Model: KD-300KC with 0.01 g accuracy (Simon and Mazlan, 2008; Alam et al., 2012). The relationships among all body length parameters were determined by the method of least squares to fit a linear regression as: $Y = \alpha + bX$. Where, Y = various body lengths, X = total length, α = proportionality constant and b = regression coefficient (Alam et al., 2014). The length-weight relationships were determined by the general equation of $TW = \alpha TL^b$ (Le Ceen, 1951). Where, TW is the total weight (expressed in g), TL is the total length (expressed in cm), "α" is a coefficient related to body form and "b" is an exponent indicating isometric growth when equal to 3 and indicating allometric growth when significantly different from 3 (Simon et al., 2009; Alam et al., 2014). The parameters "α" and "b" of the exponential curve were estimated by linear regression analysis over log-transformed data expressed as: $\log TW = \log\alpha + b\log TL$. The values of the constant "a" and "b" of the linear regression was determined by following Rounsefell and Everhart (1953) and Lagler (1966). The Fulton's condition factor, K was calculated by using the following formula: $K = (TW/TL^3) \times 100$. Where, K = Fulton's condition factor, TW = Total body weight, TL = Total body length. Here, factor 100 is used to bring K close unity. All the data were analyzed by using computer software SPSS version 15.0.

Results and Discussion

The length-length relationships with total length among standard length, dorsal length, pectoral length, pelvic length, anal length, head length and the coefficient of correlation of 9 fish species were presented in the Table 1. The relationships were found highly significant with all "r" values being >0.900. The body lengths were gradually increased with the increase of TL. The obtained regression equations clearly revealed that the lengths of the body parts are proportional to the total length. Such findings were also observed by Tandon et al. (1993) while working with the morphometry of *Cirhinus reba* Kanjli wetland of India. These relationships were also observed in *Puntius chola* (Bhuiyan and Biswas, 1982), *Mystus vittatus* (Hoque and Hossin, 1992; Hossain et al., 2006), *Parastromateus niger*, (Dadzie et al., 2008), and *P. sophore* (Alam, et al., 2012). The findings are more similar to the findings of Hossain et al. (2009) while worked on length-weight and length-length relationship of 10 small fish species from the Ganges, Bangladesh; Alam et al. (2013) and Alam et al. (2014) on length-length relationship, length-weight relationship and condition factors of some freshwater fish species of Bangladesh.

The range of length and weight parameters of the length-weight equations and values of Fulton's condition factors were shown in Table 2. The slope "b" values of the length-weight equations were obtained 3.011 for *G. giuris*, 2.812 for *E. danricus*, 2.852 for *M. pancalus*, for *L. guntea*, 3.030 for *C. faciatus*, 2.990 for *P. sophore*, 2.680 for *H. fossilis*, 2.840 for *C. Punctatus* and 2.650 for *M. cavasius*. The length-weight relationships were found highly significant with all "r" values being >0.900 where the parameter "b" remained mostly within the expected range of 2.5-3.5. Therefore, all the species seemed to be followed the cube law. The reason behind may be the observed specimens were the inhabitants of quite good environment and gravid females were more in the samples (Le Cren, 1951). The equations are therefore applicable for the total population as a whole. While working with different morphometric characters of other fish species by Bagenal and Tesch (1978), Hoque and Hossain (1992), Kiran et al. (2004), Oscoz et al. (2005), Froese (2006), Britton and Devies (2007), Aguirre et al. (2008), Arshad et al. (2008), Hossain et al. (2009), Alam et al. (2013) and Alam et al. (2014) observed

similar results.

The values of Fulton's condition factor were for *G. giuris*, *C. faciatus*, *P. sophore*, *C. punctatus*, and *M. cavasius* were being >1 indicate that growth of these species were perfect condition whereas the rest species were being <1 but very close to 1 that may

Table 1. Relationships with total length among different body lengths of nine species.

Species (Ordinate TL)	Abscissa	Mean ± SE of Abscissa	Regression equation	r
G. giuris (TL = 6.68 ± 0.13)	SL	5.18±0.10	SL = 0.3675 + 0.7211TL	0.992**
	DL	2.96±0.06	DL = 0.1298 + 0.4239TL	0.975**
	PL	1.46±0.03	PL = - 0.0073 + 0.2198TL	0.965**
	PvL	1.63±0.03	PvL = - 0.0873 + 0.2565TL	0.971**
	AL	3.08±0.06	AL = 0.0775 + 0.4498TL	0.985**
	HL	1.46±0.04	HL = - 0.6664 + 0.3182TL	0.957**
E. danricus (TL = 5.14 ± 0.09)	SL	4.07±0.07	SL = 0.1544 + 0.7488TL	0.986**
	DL	2.69±0.05	DL = 0.2761 + 0.4690TL	0.960**
	PL	1.05±0.01	PL = 0.6211 + 0.0829TL	0.909**
	PvL	2.06±0.03	PvL = 0.4480 + 0.3131TL	0.954**
	AL	2.93±0.05	AL = 0.1824 + 0.5345TL	0.983**
	HL	0.79±0.02	HL = 0.2468 + 0.1054TL	0.921**
M. pancalus (TL = 9.53 ± 0.15)	SL	8.87±0.14	SL = - 0.0425 + 0.9345TL	0.990**
	DL	1.95±0.04	DL = - 0.1427 + 0.2199TL	0.916**
	PL	1.68±0.02	PL = 0.2289 + 0.1517TL	0.939**
	PvL	-	-	-
	AL	5.40±0.08	AL = 0.1262 + 0.5535TL	0.981**
	HL	1.58±0.03	HL = 0.0587 + 0.1592TL	0.950**
L. guntea (TL = 7.17 ± 0.09)	SL	5.95±0.09	SL = - 0.5553 + 0.9074TL	0.993**
	DL	3.00±0.05	DL = - 0.3927 + 0.4729TL	0.961**
	PL	1.04±0.01	PL = 0.4795 + 0.0784TL	0.914**
	PvL	3.03±0.05	PvL = - 0.2697 + 0.4602TL	0.975**
	AL	4.67±0.07	AL = - 0.3368 + 0.6981TL	0.990**
	HL	0.90±0.02	HL = - 0.2040 + 0.1539TL	0.919**
C. fasciatus (TL = 4.97 ± 0.18)	SL	3.74±0.13	SL = 0.1033 + 0.7301TL	0.997**
	DL	1.42±0.05	DL = 0.1767 + 0.2500TL	0.962**
	PL	1.22±0.04	PL = 0.1229 + 0.2201TL	0.982**
	PvL	0.98±0.03	PvL = 0.1912 + 0.1597TL	0.972**
	AL	1.41±0.05	AL = 0.0767 + 0.2685TL	0.979**
	HL	1.12±0.04	HL = 0.1357 + 0.1982TL	0.962**
P. sophore (TL = 6.90 ± 0.12)	SL	5.33±0.10	SL = - 0.1640 + 0.7964TL	0.979**
	DL	2.70±0.05	DL = - 0.1470 + 0.4123TL	0.982**
	PL	1.32±0.02	PL = 0.1379 + 0.1715TL	0.957**
	PvL	2.60±0.05	PvL = - 0.0903 + 0.3890TL	0.962**
	AL	3.86±0.07	AL = - 0.0841 + 0.5706TL	0.985**
	HL	1.32±0.03	HL = - 0.0414 + 0.1979TL	0.932**
H. fossilis (TL = 9.09±0.19)	SL	7.96±0.17	SL = - 0.0434 + 0.8894TL	0.998**
	DL	2.63±0.06	DL = 0.1111 + 0.2803TL	0.951**
	PL	1.24±0.03	PL = 0.1048 + 0.1264TL	0.920**
	PvL	2.68±0.06	PvL = 0.1957 + 0.2764TL	0.972**
	AL	3.23±0.07	AL = 0.1560 + 0.3423TL	0.984**
	HL	1.27±0.03	HL = - 0.0169 + 0.1427TL	0.943**
C. punctatus (TL = 8.02 ± 0.18)	SL	6.43±0.15	SL = - 0.1446 + 0.8194TL	0.988**
	DL	2.29±0.08	DL = - 0.969 + 0.4064TL	0.942**
	PL	2.21±0.05	PL = - 0.1243 + 0.2910TL	0.976**
	PvL	2.44±0.06	PvL = - 0.2148 + 0.3308TL	0.976**
	AL	3.64±0.08	AL = 0.0544 + 0.4465TL	0.984**
	HL	2.38±0.05	HL = 0.1536 + 0.2773TL	0.950**
M. cavasius (TL = 6.65 ± 0.08)	SL	5.08±0.05	SL = 0.4699 + 0.6937TL	0.984**
	DL	1.98±0.02	DL = 0.3547 + 0.2440TL	0.910**
	PL	1.20±0.02	PL = - 0.3208 + 0.2289TL	0.953**
	PvL	2.59±0.03	PvL = - 0.0910 + 0.4028TL	0.947**
	AL	3.78±0.04	AL = 0.7141 + 0.4611TL	0.923**
	HL	1.24±0.01	HL = 0.4591 + 0.1172TL	0.921**

Table 2. Length-weight relationships and Fulton's condition factors of nine species.

Species	Total length characteristics		Total weight characteristics		Parameters of the relationship			Fulton's condition factor
	Range (cm)	Mean±SE	Range (cm)	Mean±SE	*α*	*b*	r	(*K*)
G. giuris	4.70-9.10	6.68 ± 0.13	1.10-5.85	2.77 ± 0.15	0.017466	3.011	0.980**	1.50
E. danricus	3.20-6.80	5.14 ± 0.09	1.00-1.30	1.14 ± 0.01	0.050511	2.812	0.904**	0.93
M. pancalus	7.00-13.70	9.53 ± 0.15	2.60-4.20	3.25 ± 0.04	0.059340	2.852	0.917**	0.99
L. guntea	4.30-8.30	7.17 ± 0.10	1.50-4.71	3.58 ± 0.10	0.008330	2.840	0.913**	0.98
C. fasciatus	3.10-7.80	4.97 ± 0.18	0.65-4.06	1.99 ± 0.16	0.004818	3.030	0.990**	1.15
P. sophore	5.20-9.50	6.90 ± 0.12	2.42-7.65	4.34 ± 0.29	0.001380	2.990	0.988**	1.32
H. fossilis	5.50-15.50	9.00 ± 0.19	1.50-9.50	4.26 ± 0.19	0.047410	2.680	0.942**	0.96
C. punctatus	5.20-11.20	8.02 ± 0.18	2.50-11.19	6.21 ± 0.32	0.068620	2.840	0.959**	1.19
M. cavasius	5.90-8.10	6.65 ± 0.08	2.40-3.60	2.93 ± 0.04	0.033610	2.650	0.904**	1.02

occur due to age and stage of maturity of the species as well as environmental conditions of habitat such as temperature, salinity and seasonality. Such findings were also observed in *Puntius chola* (Bhuiyan and Biswas, 1982), *Heteropneustes fossilis* (Mia, 1984), *Amblypharyngodon mola* (Afroze et al., 1992), *Mystus vittaus* (Hoque and Hossain, 1992), *Puntius stigma* (Islam & Hossain, 1992), *Ailia coila* (Alam et al., 1994), *Barbus canis* (Mir, 1996), *Chand ranga* (Iqbal et al., 1995-1996), *Botia lohachata* (Mortuza and Mokarrama, 2000), *Trachurus mediterraneus* (Santic et al., 2006), *Parastromateus niger* (Dadzie et al., 2008) and *P. ticto* (Hossain et al., 2012).

The outcome of the present study has provided some new and updated information on the morphometric characters of nine freshwater fish species of Nageshwari, Bangladesh. Though the fishes are small, they have very good consumer demand with relatively high nutritional value. Findings of the present investigation may play an important role in country economy being key factors for the management and conservation of these species as well as other fish species of Bangladesh.

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