JJBS

Jordan Journal of Biological Sciences

Volume 11, Number 1,March 2018
ISSN 1995-6673
Pages 81 - 85

Morphometric Relationships of the Tank goby *Glossogobius giuris* (Hamilton, 1822) in the Gorai River using Multi-linear Dimensions

Md. Abul Kalam Azad, Md. Yeamin Hossain*, Dalia Khatun, Most. Farida Parvin, Fairuz Nawer, Obaidur Rahman and Md. Alomgir Hossen

Department of Fisheries, Faculty of Agriculture, University of Rajshahi, Bangladesh.

Received July 24, 2017; Revised September 14, 2017; Accepted September 26, 2017

Abstract

The present study illustrates the first complete and inclusive information of morphometric relationships, including Length-Weight Relationships (LWRs) and Length-Length Relationships (LLRs), using a total of 13 linear dimensions of *Glossogobius giuris* (Hamilton, 1822) in the Gorai River, southwestern (SW) Bangladesh. Also meristic characters, including various fin-rays of the tank goby, have been studied. In total, 229 specimens of *G. giuris* were collected occasionally from the Gorai River during March 2016 to February 2017 by a variety of local fishing gears (e.g., cast, gill, and square lift net). Fin rays and scales (including lateral line scale) were counted by a magnifying glass. Different morphometric lengths were measured to 0.01 cm, and whole Body Weight (BW) was estimated ± 0.01 g for each individual. The fin formula of *G. giuris* is: dorsal, D_1. VI; D_2. 8–11 (II–III/8–11); pectoral, P_1. 17–22 (II–VI/14–19); pelvic, P_2. 10–13 (II–III/8–10); anal, A. 7–12 (II–IV/5–8); and caudal, C. 16–21 (IV–VIII/12–13), correspondingly. In the present study, Total Length (TL) varied from 4.3 to 26.9 cm and BW ranged from 0.67 to 146.55g. All LWRs were highly significant ($p < 0.0001$) with r^2 values ≥ 0.975. Based on r^2 value, LWR by BW *vs.* TL, BW *vs.* SL and BW *vs.* PoAnL were good fitted models among 13 equations. The present study would be very valuable for species recognition and stock assessment of tank goby in the Gorai River, SW Bangladesh and in adjoining ecosystems.

Keywords: Tank goby; Fin rays; *Glossogobius giuris;* Meristic; Morphometric.

1. Introduction

The tank goby *Glossogobius giuris* (Hamilton, 1822), belonging to the family Gobiidae, is a benthopelagic; amphidromous species occurring in sea-, brackish- and fresh-waters. It is the only species of diverse genus *Glossogobius*, found in Bangladesh, locally known as Bele (Rahman, 2005), Bhaila in India, Tank goby in Malaysia, Goby in Philippine (Freose and Pauly, 2016). *G. giuris* inhabits streams, canals, ditches and ponds. This goby fish is broadly distributed in coastal and estuarine as well as fresh waters alongside the coasts of East Africa, the Red Sea and the Indian subcontinent to China (Freose and Pauly, 2016). It is very rich in protein and micronutrients and has high market value (Islam and Joadder, 2005; Islam *et al.*, 2014). This fish is one of the dominant species in the Gorai River (SW Bangladesh); hence, it is an important capture species for small- and large- scale fishermen (Costa *et al.*, 1999; Hossain *et al.*, 2009).

Studies on morphometric and meristic features can be constructive tools for exact identification of any species and its classification (Begenal and Tesch, 1978; Jayaram, 1999; Hossen *et al.*, 2016). Moreover, in fisheries research, appraising the well-being of individuals as well as evaluating the life history and the morphological traits of populations of different locality greatly rely on morphometric characters (King, 2007; Hossain, 2010; Hossain *et al.*, 2013).

To the best of our knowledge, a few studies, including morphometric and meristic characters, Length-Weight Relationships (LWRs), food and feeding habits, reproduction and breeding performance, have been conducted on this species from other habitats (Hossain *et al.*, 2009; Mollah *et al.*, 2012; Islam and Mollah, 2013; Hossain, 2014; Islam *et al.*, 2014; Kaur and Rawal, 2015; Qambrani *et al.*, 2015; Hossain *et al.*, 2016; Saha *et al.*, 2016); however, no sound studies on this issue, covering a large number of linear dimensions, have been conducted yet from the Gorai River. Therefore, the present study is designed to describe the morphometric and meristic characteristics of *G. giuris* systematically using large number of specimens from small to larger sizes over a study period of one year from the Gorai River (SW Bangladesh).

* Corresponding author. e-mail: hossainyeamin@gmail.com.

2. Materials and Methods

In the present study, a total of 229 individuals of *G. giuris* (Figure 1) were collected occasionally from the Gorai (distributary of Ganges River) River (Latitude: 23° 32' N; Longitude: 89° 31' E), SW Bangladesh during March 2016 to February 2017 from artisanal fishers. The samples were caught using various types of traditional fishing gears, i.e., cast net (mesh size ranges: 1.5 - 2.5 cm), gill net (mesh size ranges: 1.5–2.0 cm), and square lift net (mesh size: ~2.0 cm). The fresh samples (dead fish) were instantly chilled in ice on site and preserved with 10% buffered formalin after arrival in the laboratory.

Total Body Weight (BW) of each individual was taken using a digital electric balance with 0.01 g accuracy and different linear dimensions, i.e., lengths (Table 1 and Fig. 2) were estimated to the nearest 0.01 cm using digital slide calipers. The LWR was estimated using the equation: $W = a \times L^b$, where W is the body weight (BW, g) and L is the 13 different lengths in cm. The regression parameters a and b were calculated by linear regression analyses based on natural logarithms: ln (W) = ln(a) + b ln(L). Moreover, 95% Confidence Limit (CL) of a and b and the co-efficient of determination (r^2) were estimated. Extremes outliers were removed from the regression analyses according to Froese (2006). A t-test was used to confirm whether b values obtained in the linear regressions were significantly different from the isometric (b = 3) value (Sokal and Rohlf 1987). A total of 12 LLRs were estimated by linear regression analysis (Hossain *et al*., 2006). Best/ good model for both LWRs and LLRs was selected based on the highest value of determination r^2. Total number of fin rays and scales from different body parts (including the lateral line) were counted by using magnifying glass. Statistical analyses were performed using Graph Pad Prism 6.5 software. All statistical analyses were considered significant at 5% ($p < 0.05$).

Figure 1. A photo of *Glossogobius giuris* which was collected from the Gorai River, southwestern Bangladesh

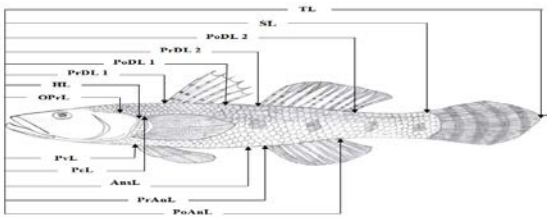

Figure 2. Showing the morphometric measurements of *Glossogobius giuris* in the Gorai River, southwestern Bangladesh

Table 1. Morphometric measurements of the *Glossogobius giuris* (Hamilton, 1822) (n = 229) captured from the Gorai River, southwestern Bangladesh

Min, minimum; Max, maximum; SD, standard deviation; CL, confidence limit for mean values; TL, total length; SL, standard length; BW, body weight; PrDL 1,1st Pre-dorsal length; PoDL 1,1st Post-dorsal length; PrDL 2, 2nd Pre-dorsal length; PoDL 2, 2nd Post-dorsal length; HL, Head length; OprL, Opercular length; PcL, Pectoral length; PvL, pelvic length; AnsL, anus length; PrAnL, pre-anal length; PoAnL, post-anal length; *, weight in g).

Measurements	Min (cm)	Max (cm)	Mean ± SD	95% CL	%TL
TL (Total length)	4.3	26.9	12.803±5.893	12.036-13.571	
SL (Standard length)	3.3	19.5	9.867±4.535	9.276-10.457	76.728
PrDL 1(1st Pre-dorsal length)	1.2	7.8	3.679±1.705	3.457-3.901	37.291
PoDL 1(1st Post-dorsal length)	1.5	10.1	4.810±2.226	4.520-5.099	37.401
PrDL 2(2nd Pre-dorsal length)	1.9	11.6	5.658±2.594	5.320-5.995	43.996
PoDL 2(2nd Post-dorsal length)	2.5	15.6	7.564±3.470	7.112-8.016	58.822
HL (Head length)	0.9	6.3	2.914±1.362	2.737-3.092	22.664
OprL (Opercular length)	0.8	6.2	2.781±1.372	2.602-2.959	21.625
PcL (Pectoral length)	0.9	6.3	2.964±1.410	2.781-3.148	23.051
PvL (Pelvic length)	1.1	6.4	3.110±1.449	2.922-3.299	24.188
AnsL(Anus length)	1.4	11.8	5.535±2.710	5.182-5.888	43.045
PrAnL(Pre-anal length)	1.9	12.3	6.000±2.766	5.640-6.360	46.658
BW (Body weight)	0.67*	146.55*	27.731±33.217	23.406-32.056	

3. Results

The body of *G. giuris* is elongated and moderately compressed, mouth oblique with prominent lower jaw and flattened head. The body color is brownish yellow with 5 to 6 dark and rounded spots on its sides. Dorsal, pectoral and caudal fins mottled with small spots where darkest spots are found along the spine of second dorsal fin. Pelvic fins united but attached to the body only from their anterior part. The morphometric measurements of *G. giuris* are shown in Figure2.

The fin formula of *G. giuris* is: dorsal, D_1. VI; D_2. 8–11 (II–III/8–11); pectoral, P_1. 17–22 (II–VI/14–19); pelvic, P_2. 10–13 (II–III/8–10); anal, A. 7–12 (II–IV/5–8); and caudal, C. 16–21 (IV–VIII/12–13), respectively. A completed lateral line is present. There are about 32-33 scales in lateral line and 5.5 scales above lateral line and 6.5 scales below the lateral line. All morphometric and meristic measurements are presented in Table 1 and 2, respectively. In the present study, TL was ranged from 4.3 to 26.9 cm (mean ± SD = 12.80±5.89) and the BW was varied from 0.67 to 146.55g (mean ± SD = 27.731±33.217). The standard length (76.73%) contains the high percentage of TL (Table 1).

The regression parameters (*a* and *b*), with their 95% confidence intervals for LWRs, coefficients of determination (r^2) of *G. giuris*, are given in Table 2. All LWRs were highly significant ($p < 0.0001$) with r^2 values ≥ 0.975. Based on r^2 value, LWR by BW *vs.* TL, BW *vs.* SL and BW *vs.* PoAnL were good fitted models among the 13 equations.

Also, the LLRs are presented in Table 3 and all LLRs were also highly correlated with r^2 values ≥ 0.990. According to r^2 value, LLR by TL *vs.* SL; TL *vs.* PoDL 2; TL *vs.* PrAnL and TL *vs.* PoAnL were good fitted models among 12 equations.

Table 2. Descriptive statistics and estimated parameters of the length-weight relationships of *Glossogobius giuris* (Hamilton, 1822) (*n* = 229) from the Gorai River, southwestern Bangladesh

Equation	Regression parameter		95% CL of *a*	95% CL of *b*	r^2
	a	*b*			
BW= $a \times TL^b$	0.0102	2.910	0.0096-0.0102	2.882-2.937	0.995
BW= $a \times SL^b$	0.0222	2.902	0.0209-0.0236	2.875-2.929	0.995
BW= $a \times$ PrDL 1^b	0.4168	2.849	0.3974-0.4370	2.812-2.886	0.990
BW= $a \times$ PoDL 1^b	0.1862	2.876	0.1773-0.1957	2.844-2.908	0.993
BW= $a \times$ PrDL 2^b	0.1104	2.907	0.1046-0.1165	2.875-2.939	0.993
BW= $a \times$ PoDL 2^b	0.0487	2.895	0.0460-0.0515	2.866-2.924	0.994
BW= $a \times HL^b$	0.8289	2.827	0.7797-0.8812	2.770-2.885	0.976
BW= $a \times OprL^b$	1.1287	2.672	1.0669-1.1941	2.617-2.726	0.975
BW= $a \times PcL^b$	0.8422	2.775	0.7977-0.8892	2.725-2.825	0.981
BW= $a \times PvL^b$	0.6699	2.853	0.6336-0.7082	2.804-2.903	0.983
BW= $a \times AnsL^b$	0.1747	2.687	0.1654-0.1846	2.654-2.720	0.991
BW= $a \times PrAnL^b$	0.0998	2.869	0.0950-0.1049	2.841-2.897	0.994
BW= $a \times PoAnL^b$	0.0529	2.877	0.0500-0.0558	2.849-2.905	0.995

n, sample size; *a* and *b* are regression parameters; CL, confidence intervals for mean values; r^2, co-efficient of determination

Table 3. The estimated parameters of the length-length relationships ($Y = a + b \times X$) of *Glossogobius giuris* (*n*= 229) from the Gorai River, southwestern Bangladesh

Equation	Regression parameters		95% CL of *a*	95% CL of *b*	r^2
	a	*b*			
TL = $a + b\times$ SL	0.0003	1.298	-0.0976 to 0.0982	1.289-1.307	0.997
TL = $a + b\times$PrDL 1	0.1166	3.448	-0.0095 to 0.243	3.417-3.479	0.995
TL = $a + b\times$PoDL 1	0.0947	2.642	-0.0231 to 0.2126	2.620-2.665	0.996
TL = $a + b\times$PrDL 2	-0.0232	2.267	-0.1392 to 0.0927	2.249-2.86	0.996
TL = $a + b\times$PoDL 2	-0.0217	1.696	-0.1249 to 0.0814	1.683-1.708	0.997
TL = $a + b\times$ HL	0.2509	4.307	0.0714-0.4305	4.251-4.363	0.990
TL = $a + b\times$OprL	0.9208	4.273	0.7457-1.0959	4.217-4.330	0.990
TL = $a + b\times$PcL	0.4735	4.160	0.2988-0.6483	4.106-4.213	0.991
TL = $a + b\times$PvL	0.2190	4.046	0.0365 - 0.4015	3.993-4.0990	0.991
TL = $a + b\times$AnsL	0.7912	2.170	0.6831-0.8994	2.153-2.188	0.996
TL = $a + b\times$PrAnL	0.0415	2.127	-0.0612 to 0.1442	2.111-2.143	0.997
TL = $a + b\times$PoAnL	0.0618	1.711	-0.0381 to 0.1616	1.698-1.723	0.997

SL, standard length; ; PrDL 1,1st Pre-dorsal length; PoDL 1,1st Post-dorsal length; PrDL 2, 2nd Pre-dorsal length; PoDL 2, 2nd Post-dorsal length; HL, Head length; OprL, Opercular length; PcL, Pectoral length; PvL, pelvic length; AnsL, anus length; PrAnL, pre-anal length; PoAnL, post-anal length; *a*, intercept; *b*, slope; CL, confidence limit for mean values; r^2, co-efficient of determination.

4. Discussion

The present study illustrates the first complete information on morphometric (LWRs and LLRs) and meristic characteristics of *G. giuris* from the Gorai River, southwestern Bangladesh. In this study, a total of 229 individuals from small to larger body sizes were used; however, it was not possible to collect *G. giuris* smaller than 4.3 cm TL, which can be attributed that the fishermen failed to catch the smaller size or selectivity of fishing gears (Hossain *et al.*, 2012; Hossain *et al.*, 2016a, b). In the present study, the maximum length was found 26.9 cm TL, which is quite close to the study of Talwar and Jhingran, 1991 (30 cm) but lower than the maximum recorded value of 50.0 cm SL (Eccles, 1992). The absence of maximum sizes of *G. giuris* in the Gorai River might be due to either the absence of larger-sized individuals in the populations in the fishing grounds (Hossain *et al.*, 2016c, d; 2017) or fishermen did not go where the larger size exist. Indeed, maximum length is a helpful fool to estimate the growth parameters (i.e., asymptotic length, growth coefficient), thereby important for fisheries resource planning and management (Ahmed *et al.*, 2012; Hossain, 2016b, 2017).

The allometric co-efficient (*b*) values of LWRs may vary between 2.0 and 4.0 (Carlander, 1969); however, values ranging from 2.5 to 3.5 are more common (Froese, 2006). In the present study, most of the *b* values were within the limit (2.67–2.91) indicating negative allometric growth pattern for *G. giuris* in the Gorai River, SW Bangladesh which was dissimilar with Hossain *et al.* (2009) (*b*= 3.07-3.09). However, the *b* values may vary in the same species due to the amalgamation of one or more factors including variations of growth in different body parts, sex, physiology, preservation methods and differences in the observed length ranges of the specimens collected (Tesch, 1971; Hossen *et al*., 2016; Hossain *et al*., 2015; 2017, Nawer *et al.*, 2017), which were excluded during the present study. In addition, all LLRs were highly correlated, which is not in accordance with Hossain *et al.* (2009). However, the present study found the best/good model among equations using a number of different lengths based on coefficient of determination, which would be very effective for comparison with any future studies.

In the present study, 6 fin rays in 1st dorsal fin and 8–11 in 2nd dorsal fin, 17–22 pectoral fin rays, 10–12 rays in attached pelvic fin, 7–12 anal fin rays and 16–21 caudal fin rays were observed, which was more or less similar with the studies done by Talwar and Jhingran (1991) and Rahman (2005). Besides, we found a total of 32-33 scales in lateral line, which is in agreement with Rahman (2005).

In conclusion, these findings would be a helpful tool for taxonomists to recognize *G. giuris* and for fishery managers/ biologists to instigate the stock assessment of the remaining stocks of this species in the Gorai River, SW Bangladesh and other subtropical countries. Also, these results will impart an important baseline for future studies within the Gorai River and surrounding ecosystems.

Acknowledgement

The authors would like to extend their sincere appreciation to (i) TWAS for research grants (Ref: RGA No. 14-028 RG/BIO/AS_1; UNESCO FR: 324028574), (ii) BARC, PIU, NATP-2, Sub-project ID: 484 for technical (usage of equipments) supports. The present study is part of the research for M. Phil degree of the senior author M.A.K. Azad.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of the present paper.

References

Ahmed ZF, Hossain MY and Ohtomi J. 2012. Modeling the growth of silver hatchet chela *Chela cachius* (Cyprinidae) from the Old Brahmaputra River in Bangladesh using multiple functions. *Zool Stud*, **51**: 336–344.

Bagenal JB and Tesch FW. 1978. **Methods for assessment of fish production in freshwaters**. Blackwell Scientific publication, Oxford, p.361.

Carlander KD. 1969. **Handbook of freshwater fishery biology**, Vol. 1. The Iowa State University Press, Ames, IA, p.752.

Costa T, Begum A and Alam SMN. 1999. **From exclusion to collective ownership: A case study of user-group representatives in fisheries management in Bangladesh**. Caritas and Department of Fisheries (DoF), Bangladesh.

Eccles DH.1992. **FAO species identification sheets for fishery purposes**. Field guide to the freshwater fishes of Tanzania. Prepared and published with the support of the United Nations Development Programme (project URT/87/016). FAO, Rome. p.145.

Froese R and Pauly D. (Eds.) 2016. **Fish base 2016**, World Wide Web electronic publication. Available at: http://www.fishbase.org (accessed on 24 November 2016).

Froese R. 2006. Cube law, condition factor and weight-length relationships: History, meta-analysis and recommendations. *J Appl Ichthyol*, **22**: 241–253.

Hossain MS, Roy A and Rahman ML**.** 2016. Food and feeding habit of Bele *Glossogobius giuris* (Hamilton and Buchannan, 1822) collected from Mithamain *Haor* of Kishoreganj districts, northeastern Bangladesh. *Int J Fish Aquat Stud*, **4**: 84–88.

Hossain MS, Sultana N. 2014. Morphometric characters and length- weight relationship of Bele, (*Glossogobius giuris*) from Mithamoin Hair, Kissorgonj, Bangladesh. *J Bangladesh Agril Univ*, **12**: 389–395.

Hossain MS. 2014. Reproductive Characteristics of Bele, *Glossogobius giuris* from Mithamoin *Haor*, Kissorgonj, Bangladesh. *World J Fish & Marine Sci*, **6**: 537–543.

Hossain MY. 2010. Morphometric relationships of length-weight and length-length of four Cyprinid small indigenous fish species from the Padma River (NW Bangladesh). *Turk J Fish Aquat Sci*, **10**: 131–134.

Hossain MY, Ahmed ZF, Leunda PM, Jasmine S, Oscoz J, Miranda R and Ohtomi J. 2006. Condition, length-weight and length-length relationships of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Mathabhanga River, southwestern Bangladesh. *J Appl Ichthyol*, **22**: 304–307.

Hossain MY, Hossen MA, Khairun Y, Bahkali AH and Elgorban AM. 2016a. Length-weight relationships of *Dermogenys pusilla*

(Zenarchopteridae) and *Labeo bata* (Cyprinidae) in the Ganges River (NW Bangladesh). *J Appl Ichthyol*, **32**: 744-746.

Hossain MY, Hossen MA, Khatun D, Nawer F, Parvin MF, Rahman O and Hossain MA. 2017. Growth, condition, maturity and mortality of the Gangetic Leaf fish *Nandus nandus* (Hamilton, 1822) in the Ganges River (Northwestern Bangladesh). *Jordan J Biol Sci*, **10**: 57-62.

Hossain MY, Hossen MA, Pramanik MNU, Ahmed ZF, Hossain MA and Islam MM. 2016b. Length–weight and length–length relationships of three Ambassid fishes from the Ganges River (NW Bangladesh). *J Appl Ichthyol*, **32**: 1279-1281.

Hossain MY, Naser SMA, Bahkali AH, Yahya K, Hossen MA and Elgorban AM. 2016c. Life history traits of the flying barb *Esomus danricus* (Hamilton, 1822) (Cyprinidae) in the Ganges River, Northwestern Bangladesh. *Pak J Zool*, **48**: 399-408.

Hossain MY. Ohtomi J. Ahmed ZF, Ibrahim AHM and Jasmine S. 2009. Length-weight and morphometric relationships of the Tank goby *Glossogobius giuris* (Hamilton, 1822) (Perciformes: Gobiidae) in the Ganges of Northwestern Bangladesh. *Asian Fish Sci*, **22**: 961–969.

Hossain MY, Rahman MM, Abdallah EM and Ohtomi J. 2013. Biometric relationships of the Pool barb *Puntius sophore* (Hamilton 1822) (Cyprinidae) from three major rivers of Bangladesh. *Sains Malays*, **22**: 1571**–**1580.

Hossain MY, Rahman MM, Bahkali AH, Yahya K, Arefin MS, Hossain MI, Elgorban AM, Hossen MA, Islam MM and Masood Z., 2016d. Temporal variations of sex ratio, length-weight relationships and condition factor of *Cabdio morar* (Cyprinidae) in the Jamuna (Brahmaputra River distributary) River, Northern Bangladesh. *Pak J Zool*, **48**: 1099-107.

Hossain MY, Rahman MM, Fulanda B, Jewel MAS, Ahamed F and Ohtomi J. 2012. Length–weight and length–length relationships of five threatened fish species from the Jamuna (Brahmaputra River tributary) River, northern Bangladesh. *J Appl Ichthyol*, **28**: 275–277.

Hossain MY, Sayed SRM, Rahman MM, Ali MM, Hossen MA, Elgorban AM, Ahmed ZF and Ohtomi J. 2015d. Length-weight relationships of nine fish species from the Tetulia River, southern Bangladesh. *J Appl Ichthyol*, **31**: 967- 969.

Hossen MA, Hossain MY, Pramanik MNU, Nawer F, Khatun D, Parvin MF and Rahman MM. 2016. Morphological Characters of *Botia lohachata*. *J Coast Life Med*, **4**: 689-692.

Islam MN and Joadder MAR. 2005. Seasonal variation of the proximate composition of freshwater gobi, *G. giuris* (Hamilton) from the river Padma. *Pak J Biol Sci*, **8**: 532–536.

Islam MR and Mollah MFA. 2013. Morphological observation and PG-induced breeding of *Glossogobius giuris* (hamilton 1822). *J Sci Technol*, **11**: 171-180.

Islam MS, Tuly DM, Hasnahena M, Bahadur P and Hassan MR. 2014. Induced breeding of freshwater Goby, *Glossogobius giuris* (Hamilton,1822) in the Captivity: A preliminary Study. *J Fish Aquat Sci*, **9**: 24-32.

Jayaram KC. 1999. **The Freshwater Fishes of the Indian Region**. Narendra Publishing House, Delhi. P.551.

Kaur V and Rawal YK. 2015. Length-weight relationship in *Glossogobius giuris* (Ham.) from Sukhna Lake, Chandigarh. *Int J Sci Res*, **4**: 2007-2009.

King M. 2007. **Fisheries Biology, Assessment and Management**. 2nd edition, Oxford Press, London, p.382.

Mollah MFA, Yeasmine S, Hossen MB and Ahammad AKS. 2012. Landmark-based morphometric and meristic variations of *Glossogobius giuris* in three stocks. *J Bangladesh Agril Univ*, **10**: 375–384.

Nawer F, Hossain MY, Hossen MA, Khatun D, Parvin MF, Ohtomi J and Islam MA. 2017. Morphometric relationships of the endangered Ticto barb *Pethia ticto* (Hamilton, 1822) in the Ganges River (NW Bangladesh) through multi-linear dimensions. *Jordan J Biol Sci*, **10:** 199-203.

Qambrani GR, Soomro AN, Palh ZA, Baloch WA and Tabasum S. 2015. Reproductive biology of *Glossogobius giuris* (Hamilton), in Manchar Lake Sindh, Pakistan *J Aquac Res Development* **6**: 392.

Rahman AKA, 2005. ***Freshwater Fishes of Bangladesh*** (Second edition). The Zoological Society of Bangladesh, Department of Zoology, University of Dhaka, Dhaka-1000, 394 pp.

Saha BK, Hassan MF and Saha A. 2016. Some aspects of biology of the bar-eyed Goby *Glossogobius giuris* (Hamilton 1822) (Perciformes: Gobiidae) from Netrakona. *J Asiat Soc Bangladesh Sci*, **42**: 95–106.

Sokal RR and Rohlf FJ. (Eds.) 1987. **Introduction to biostatistics**, 2nd Edition, Freeman Publication, New York. P.887.

Talwar PK and Jhingran AG. 1991. **Inland fishes of India and adjacent countries.** A.A. Balkema, Rotterdam, p.541.

Tesch FW. 1971. **Age and growth. In: Methods for assessment of fish production in fresh waters (ed. W.E. Ricker)**. Blackwell Scientific Publications, Oxford, pp.99–13.