JJBS

Jordan Journal of Biological Sciences

Volume 12, Number 4,September 2019
ISSN 1995-6673
Pages 467 - 470

Morphometric and Meristic Characteristics of the Asian Stinging Catfish *Heteropneustes fossilis* (Bloch, 1794): A Key for Identification

Md. Ataur Rahman, Md. Rabiul Hasan, Md. Yeamin Hossain*, Md. Akhtarul Islam, Dalia Khatun, Obaidur Rahman, Zannatul Mawa, Md. Sahinoor Islam, Asma Afroz Chowdhury, Most. Farida Parvin and Halima Khatun

Department of Fisheries, Faculty of Agriculture, University of Rajshahi, Rajshahi 6205, Bangladesh

Received November 18, 2018; Revised January 9, 2019; Accepted January 14, 2019

Abstract

The present study revealed the first complete information on meristic counts covering various fin rays and morphometric characteristics using multi-linear dimensions of *Heteropneustes fossilis*, including length-weight relationships (LWRs) and length-length relationships (LLRs) of *H. fossilis* from the Gajner *Beel*, a wetland ecosystem in northwestern (NW) Bangladesh. A total of 333 individuals of *H. fossilis* were captured by different traditional fishing gears such as cast net, square lift net, gill net, and conical trap between July 2017 and June 2018. For each individual, the total numbers of fin rays were counted using a magnifying glass. The body weight (BW) was measured by a digital balance and various lengths (TL, SL, PrDL etc.) were taken using digital slide calipers to the nearest 0.01 g and 0.01 cm, accuracy, respectively. BW ranged from 3.50 to 105.23 g, and TL varied from 6.70 to 26.80 cm. The fin formula of *H. fossilis* is: dorsal, D. 6; pectoral, Pc.1/6-7; pelvic, Pv. 6; anal, A. 64-69; and caudal, C.16-18. All LWRs were significantly correlated ($p<0.001$), with r^2 values ≥ 0.949. The calculated *b* values showed positive allometric growth in combined sexes ($b > 3.00$). LLRs were also highly correlated ($p < 0.001$) with r^2 values ≥ 0.989. The findings of the current study can be very effective for species identification, stock assessment, and proper management of this particular species in the Gajner *Beel* of Bangladesh and the surrounding ecosystems.

Keywords: *Heteropneustes fossilis*, Morphometric, Meristic, Fin rays.

1. Introduction

Morphometric and meristic characteristics are helpful for the recognition and classification of species (Bagenal and Tesch, 1978; Jayaram, 1999; Hossain *et al*., 2016). In addition, morphometric traits play an important role in fisheries research, as they are used for comparing life history and morphological characteristics of populations across regions (Hossain *et al*., 2013; Parvin *et al.*, 2018; Khatun *et al.*, 2019). The Asian stinging catfish, *Heteropneustes fossilis* (Bloch 1974, family Heteropneustidae) is a commercially important fish species in Bangladesh. This species is locally known as *Shingi* or *Singhee* (Rahman, 1989). It is widely distributed throughout the south and southeast Asian countries including Bangladesh, India, Laos, Myanmar, Nepal, Pakistan, Sri Lanka, and Thailand (Talwar and Jhingran, 1991). *H. fossilis* is also found in Iran and Iraq (Coad, 1996; FAO, 1997). The species mostly inhabits ponds, ditches, swamps, and marshlands, but sometimes inhabits muddy rivers (Froese and Pauly, 2018). It is categorized as least concern both in Bangladesh (IUCN Bangladesh, 2015) and worldwide (IUCN, 2017).

Very little research has been done on the morphometric and meristic traits of this fish. However, some attempts have been made to study length-length (LLR) (Alam and Ferdaushy, 2015) and length-weight relationships (LWRs) (Khan *et al*., 2012; Alam and Ferdaushy, 2015; Das *et al*., 2015; Hossain *et al*., 2017; Muhammad *et al*., 2017) of this fish species. However, no studies cover morphometric (except LWR, Hossain *et. al* 2017) and meristic traits using the multi-linear dimensions of *H. fossilis* from the Gajner *Beel* ecosystem of Bangladesh. Therefore, the present study describes the morphometric characters and meristic counts of *H. fossilis* in this large wetland ecosystem.

2. Material and Methods

2.1. Study Area and Sampling

The current study was carried out in the Gajner *Beel* (Lat. 23° 55′ N; Long. 89° 33′ E). A total of 333 individuals of *H. fossilis* were occasionally collected from fishermen between July 2017 and June 2018. This fish is typically captured by various customary fishing gears such as cast nets (mesh size: 1.0–2.0 cm), gill nets (mesh size: 1.5–2.5 cm), and square lift nets (mesh size ~1.0 cm).

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

The collected specimens were instantly chilled in ice on site and preserved with 10 % buffered formalin upon arrival in the laboratory.

2.2. Meristic Count

The total numbers of fin rays were counted using a magnifying glass.

2.3. Morphological (Length-weight relationships, LWRs; length-length relationships, LLRs) relationships

The total body weight (BW) of each individual was weighed using an electronic balance, whereas various and different linear dimensions (lengths) (Table 1 and Figure 1 and 2) were taken by digital slide calipers to the nearest 0.01 g and 0.01 cm accuracy, respectively. LWRs were calculated with the equation: $W = a \times L^b$, where W is the body weight (BW, g) and L is the seven different lengths in cm. The parameters a and b were calculated through log-log linear regression analyses: $\ln(W) = \ln(a) + b \ln(L)$.

Moreover, a 95 % confidence limit (CL) of a and b and the co-efficient of determination (r^2) were estimated. Extreme outliers were excluded from the regression analyses according to Froese, (2006). A t-test was used to verify whether b values obtained in the linear regressions were significantly dissimilar from the isometric value (b = 3) (Sokal and Rohlf, 1987). In the present study, a total six LLRs were relative to TL analyzed by linear regression analysis (Hossain *et al*., 2006). The best model for both LWRs and LLRs was selected depending on the highest coefficient determination r^2. Statistical analyses were carried out with Graph Pad Prism 6.5 software. All statistical analyses were considered significant at the level of 5 % ($p < 0.05$).

Table 1. Morphometric measurements of the *Heteropneustes fossilis* (Bloch, 1794) (n = 333) captured from a wetland ecosystem, Bangladesh

Measurements	Min (cm)	Max (cm)	Mode (cm)	Mean ± SD(cm)	95% CI (cm)	%TL
TL (Total length)	6.7	26.80	13.0	14.40± 2.97	14.08 - 14.72	-
SL (Standard length)	6.0	24.50	10.5	12.95± 2.73	12.66 - 13.24	91.41
PrDL (Pre-dorsal length)	2.0	7.80	3.2	3.99± 0.88	3.89 - 4.08	29.100
PcL (Pre pectoral length)	0.7	3.70	1.9	1.81± 0.42	1.77 - 1.86	13.80
PvL(Pre pelvic length)	1.9	8.10	3.5	4.17± 0.94	4.07- 4.27	30.22
PrAnL (Pre-anal length)	2.5	9.80	4.5	5.10± 1.12	4.97 - 5.22	33.95
PoAnL (Post-anal length)	6.0	24.10	11.0	12.74± 2.72	12.44 - 13.03	89.92
BW(Body weight)	3.5	105.23	12.1	18.22± 12.82	16.84 - 19.60	

Min, minimum; Max, maximum; Mode; SD, standard deviation; CI, confidence interval for mean values; TL, total length.

Figure 1. A photo of *Heteropneustes fossilis* captured from the Gajner *Beel*, northwestern Bangladesh.

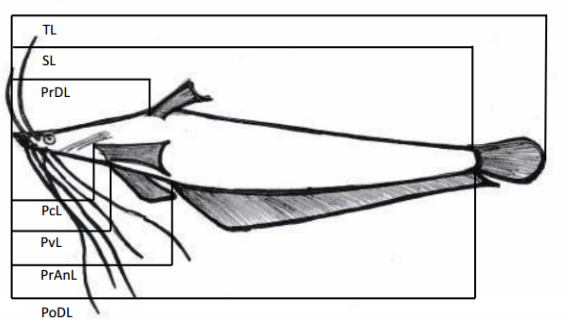

Figure 2. A photo of *Heteropneustes fossilis* where various lengths were indicated by line. (See Table 1 for abbreviation)

3. Results

3.1. Meristic Study

The body of *H. fossilis* is yellow or dark purplish-brown dorsally and lighter ventrally. The mouth is long and a pectoral spine is attached to rays by a membrane with 3-4 antrorse serrae along the inner edge at the anterior tip. It has separated anal and caudal fins with a distinct notch (Figure 3). The fin formula of *H. fossilis* is: dorsal, D. 6; pectoral, Pc.1/6-7; pelvic, Pv. 6; anal, A. 64-69; and caudal, C. 16-18 which is given in Table 2.

Table 2. Meristic counts of *Heteropneustes fossilis* (Bloch, 1994) (n = 333) captured from a wetland ecosystem, Bangladesh.

Meristic data	Numbers
Dorsal fin rays	6
Pectoral fin rays	7 – 8
Pelvic fin rays	6
Anal fin rays	64 – 69
Caudal fin rays	16 – 18

3.2. Morphological Relationships

In this study, BW ranged from 3.50 to105.23 g (mean ± SD = 7.06 ±2.88) and TL varied from 6.7 to 26.8 cm (mean ± SD = 14.40 ±2.97). The standard length (91.41%) contains higher proportion of TL of this fish. The regression parameters (a and b), their 95 % confidence intervals and coefficients of determination (r^2) for LWRs of *H. fossilis* are given in Table 3. All LWRs were highly significant ($p < 0.001$) with r^2 values ≥ 0.949. Based on the maximum r^2 value, LWR by BW *vs.* TL was the best fitted model among seven equations. LLRs which are shown in Table 4 were all highly correlated with r^2 values ≥ 0.989. Based on the maximum r^2 value, LLR by TL *vs.* SL was the best fitted model among six equations.

Table 3. Descriptive statistics and estimated parameters of the length-weight relationships of *Heteropneustes fossilis* (Bloch, 1794) (n = 333) captured from a wetland ecosystem, Bangladesh

Equation	Regression parameters		95% CI of *a*	95% CI of *b*	r^2
	a	*b*			
$BW = a*TL^b$	0.0042	3.08	0.0035 - 0.0052	3.008 - 3.154	0.954
$BW = a*SL^b$	0.0072	3.00	0.0060 - 0.0087	2.928 - 3.077	0.949
$BW = a*PrDL^b$	0.3017	2.86	0.2744 - 0.3317	2.794 - 2.931	0.952
$BW = a*PcL^b$	3.2040	2.68	3.0770- 3.3351	2.620 - 2.751	0.951
$BW = a*PvL^b$	0.2803	2.826	0.2542 - 0.3090	2.757 - 2.894	0.951
$BW = a*PrAnL^b$	0.1478	2.869	0.1319 - 0.1657	2.798 - 2.939	0.950
$BW = a*PoDL^b$	0.0084	2.965	0.0069 - 0.0101	2.892 - 3.038	0.950

n, sample size; *a* and *b* are LWR parameters; CI, confidence intervals; r^2, coefficient of determination

Table 4. The estimated parameters of the length-length relationships (y = a+ b*x) *Heteropneustes fossilis* (Bloch, 1794) (n = 333) captured from a wetland ecosystem, Bangladesh.

Equation	Regression parameters		95% CI of *a*	95% Cl of *b*	r^2
	a	*b*			
TL = a+b*SL	0.3737	1.08	0.2643 - 0.4830	1.075 - 1.092	0.995
TL= a+b*PrDL	1.0829	3.33	0.9355 -1.2304	3.303 - 3.375	0.990
TL= a+b*PcL	1.7863	6.94	1.6452 - 1.9274	6.873 - 7.024	0.989
TL= a+b*PvL	1.2905	3.14	1.1451 - 1.4358	3.110 - 3.178	0.990
TL= a+b*PrAnL	1.0516	2.61	0.9026 - 1.2006	2.590 - 2.647	0.989
TL= a+b*PoDL	0.5663	1.08	0.4618 - 0.6784	1.078 - 1.094	0.995

n, sample size*; a*, intercept*; b*, slope; CI, confidence intervals; r^2, coefficient of determination

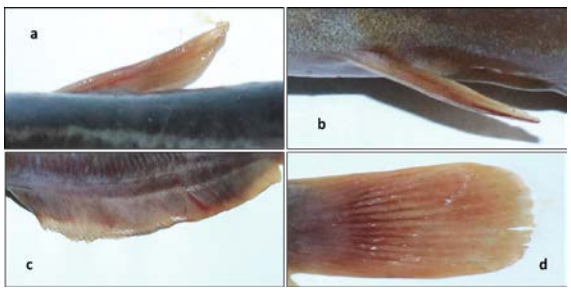

Figure 3. Different fins such as (a) Dorsal, (b) Pectoral, (c) Pelvic and (d) Caudal of *Heteropneustes fossilis*

4. Discussion

Data on the morphometric characteristics of *Heteropneustes fossilis* are scant in the literature from Bangladesh and elsewhere. However, the current study revealed the morphometric characteristics of *H. fossilis*, including length-weight relationships using several length measurements (TL, SL, PrDL, etc.), length-length relationship, and meristics in the Gajner *Beel*, a wetland ecosystem of Bangladesh.

In this study, various specimens of small to large body sizes were sampled using traditional fishing gears. This study found six dorsal fin rays; 1/6-7 pectoral fin rays, 6 pelvic fin rays, 64-69 anal fin rays, and 16-18 caudal fin rays, which is quite similar to D. 7; V. 6; A. 70; C. 19 (Bhuiyan, 1964); D. 6-7; P1. 1/6-7; P2. 6; A. 62-70 (Rahman, 1989); and D. 7; P. 7; V. 6; A. 60-79; C. 19 (Shafi and Quddus, 2001). Morphometric and meristic characters can provide key information for the species identification.

In the current study, the maximum length of *H. fossilis* recorded was 26.8 cm TL, which is lower than the maximum known TL of 31.0 cm, recorded in the Ganga River, India (Khan *et al*., 2012). Information on maximum length is necessary to estimate the population parameters including asymptotic length and growth coefficient of fishes, which is important for fisheries' resource planning and management (Hossain *et al*., 2012; Hossen *et al*., 2019; Hossain *et al*., 2019).

It was found that the calculated *b* values lie between 3.08 and 3.15 for LWR (TL *vs*. BW) of *H. fossilis* from the Gajner *Beel* wetland ecosystem. The *b* values ranging from 2.5 to 3.5 are more common (Carlander, 1969; Froese, 2006). In general, *b* values, being close to 3, indicate that fish grow isometrically, and that is different from the 3.0 value which indicates an allometric growth (>3 positive allometry and <3 negative allometry) (Tesch, 1971).

In the current study, *b* values of 3.08 (TL *vs*. BW) indicate a positive allometric growth for *H. fossilis* in the Gajner *Beel* wetland ecosystem, NW Bangladesh. A recent study by Khan *et al*. (2012) recorded a positive allometry for *H. fossilis* from the Ganges River, India. Similar findings were also reported by Hossain *et al*. (2017) in an earlier study from the Gajner *Beel* floodplain in NW Bangladesh.

The data of *H. fossilis* were collected over an extended period of time, not representative of any particular season, so they should be treated only as mean-annual values for comparative purposes. The LLRs of *H. fossilis* are highly correlated. Despite the limited literature data, the present study found the best model among equations using different lengths based on coefficient of determination, to offer a baseline for comparison with future studies using any linear dimension.

5. Conclusion

The results of this study can be fruitful tools for fish taxonomists (species identification), fishery managers, fish biologists, and conservationists to initiate early management strategies and regulations for the sustainable conservation of this species in the wetlands and the surrounding ecosystems.

Acknowledgments

The authors would like to extend their sincere appreciation to the PIU-BARC, NATP-2, Sub-Project ID: 484 for providing funding to carry out this research in the Gajner *Beel* ecosystem which is a partial work of the CRG (Competitive Research Grants) Project.

Conflicts of Interest

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

References

Alam MM and Ferdaushy MH. 2015. Length-length and length-weight relationships and condition factor of nine freshwater fish species of Nageshwari, Bangladesh. *Int J Aqua Bio*, **3:** 149-154.

Bagenal JB and Tesch FW.1978. Methods for **Assessment of Fish Production in Freshwaters**. Blackwell Scientific publication, Oxford, p. 361.

Bhuiyan AL. 1964. **Fishes of Dacca**. Asiatic Society of Pakistan, pub. 1, No.13. Dacca. p, 148.

Coad BW. 1996. Exotic fish species in the Tigris-Euphratus basin. *Zool Middle East*, **13:**71-83.

Carlander KD. 1969. **Handbook of Freshwater Fishery Biology**. Vol.1. The Iowa State University Press. Ames, IA, p. 752.

Das PW, Rahman K, Talukdar and Deka P. 2015. Length-weight relationship and relative condition factor of *Heteropneustes fossilis* (Bloch) of Deepar *Beel*, a Ramsar site of Assam, *Indian J Appl Res*, **12:** 1024-1027.

FAO. 1997. FAO database on introduced aquatic species. FAO Database on Introduced Aquatic Species, FAO, Rome.

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

Froese R and Pauly D. (Eds). 2018. ***Fish Base 2018***, World Wide Web electronic publication. Available at: http://www.fishbase.org (accessed on 25Apri 2018).

Hossain MA, Hossain, MY, Hossen MA, Rahman MA, Islam MA, Khatun D, Nawer F and Ohtomi J. 2019. Temporal variations of sex ratio and growth pattern of critically endangered catfish *Clupisoma garua* from the Ganges River of north-western Bangladesh. *Indian J Geo- Mar Sci*, **48**: 647-653.

Hossain MY, Hossen MA, Ahmed FZ, Hossain AM, Pramanik MNU, Paul AK, Nawer F, Khatun D, Haque N and Islam MA. 2017. Length–weight relationships of 12 indigenous fish species in the Gajner *Beel* floodplain (NW Bangladesh*), J Appl Ichthyol*, **33:** 842-845.

Hossain MY, Ahmed ZF, Leund PM, Jasmine S, Scoz J, Miranda R and Ohtomi J. 2006. 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, Naser SMA, Bahkali AH, Yahya K, Hossen MA, Elgorban AM, Islam MM and Rahman MM. 2016. 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, 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*, **42:** 1571**–**1580.

Hossain MY, Rahman MM, Jewel MAS, Ahmed ZF, Ahamed F, Fulanda B, Abdallah EM and Ohtomi J. 2012. Condition- and form-factor of the five threatened fishes from the Jamuna (Brahmaputra River distributary) River, northern Bangladesh. *Sains Malays*, **41:** 671–678.

Hossen MA, Paul AK, Hossain MY, Ohtomi J, Sabbir W, Rahman O, Jasmin J, Khan MN, Islam MA, Rahman MA, Khatun D and Kamaruzzaman S. 2019. Estimation of biometric indices for Snakehead *Channa punctata* (Bloch, 1793) through Multi-model Inferences. *Jordan J Biol Sci*, **12**: 197-202.

IUCN Bangladesh. 2015. **Red List of Bangladesh. Volume 5: Freshwater Fishes.** IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, xvi+360 pp.

IUCN. 2017. **The IUCN Red List of Threatened Species**. Version 2017-18. Downloaded on 18 May 2018.https:// www.iucnredlist.org.

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

Khan MA, Khan S and Miyan K. 2012. Length–weight relationship of giant snakehead, *Channa marulius* and stinging catfish, *Heteropneustes fossilis* from the River Ganga, India. *J. Appl. Ichthyol*, **28:** 154–155.

Khatun D, Hossain MY, Rahman MA, Islam MA, Rahman O, Sharmin MS, Parvin MF, Haque ATU and Hossain MA. 2019. Life-history traits of the climbing perch *Anabas testeudineus* (Bloch, 1792) in a wetland ecosystem. *Jordan J Biol Sci*, **12:** 175-182.

Muhammad HZ, Iqbal Q, Bashir MA and Hanif. 2017. Length-weight relationship and condition factor of catfish species from Indus River, Pakistan, *Punjab University J Zool*, **32:** 35-38.

Parvin MF, Hossain MY, Nawer F, Khatun D, Rahman M A, Islam M A, Rahman O and Sharmin MS. 2018. Morphometric and meristic characteristics of *Salmostoma bacaila* (Hamilton, 1822) (Cyprinidae) from the Ganges river, Northwestern Bangladesh. *Jordan J Biol Sci*, **11:** 533-536.

Rahman AKA. 1989. **Freshwater Fishes of Bangladesh**. Zoological Society of Bangladesh, Department of Zoology, University of Dhaka. p. 364.

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

Shafi M and Quddus MMA. 2001. **Fisheries Bangladesh**, Kabir publications, Dhaka, P. 483

Talwar PK, 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**, edited by Ricker, W.E. Oxford: Blackwell Scientific Publications, 98-130 pp.