Morphometric and meristic characteristics of Spotted snakehead *Channa punctata* (Bloch, 1793) in a wetland ecosystem (NW Bangladesh) using multi-linear dimensions

M A Islam[a], Z Mawa[a], M Y Hossain*[,a], M A Rahman[a], M R Hasan[a], D Khatun[a], A A Chowdhury[a], O Rahman[a], M A Rahman[a], S Tanjin[a], Habib-Ul-Hassan[b] & J Ohtomi[c]

[a]Department of Fisheries, Faculty of Agriculture, University of Rajshahi, Rajshahi – 6205, Bangladesh

[b]Department of Zoology (MRCC), University of Karachi, Karachi – 75270, Pakistan

[c]Faculty of Fisheries, Kagoshima University, 4-50-20 Shimoarata, Kagoshima – 890-0056, Japan

*[E-mail: hossainyeamin@gmail.com]

This research work affirms the morphometric characters and meristic counts of *Channa punctata* (Bloch, 1793) in a wetland ecosystem (Gajner *Beel*) from the northwestern Bangladesh. A sum of 307 specimens of *C. punctata* were sampled intermittently from the Gajner *Beel* during July 2017 to December 2018, using different established fishing gears (cast net, gill net and square lift net with mesh size ranges: 1.50-2.50 cm, 1.50-2.00 cm, & ~2.00 cm, respectively). Fin rays were counted by a magnifying glass. Seven diverse morphometric lengths were assessed and BW (body weight) was weighted for each specimen. The fin formula was: dorsal, D. 30-32; pectoral, P_1. 15-17; pelvic, P_2.5; anal, A. 19-21; and caudal, C. (ii -iv/12-14). Minimum and maximum sizes were 5.80 and 23.00 cm in total length (TL), whereas BWs were 1.96 and 126.90 g, respectively. All length-weight relationships (LWRs) were greatly significant ($p < 0.001$) with $r^2 \geq 0.986$. Based on r^2 value, BW = $0.0112*(TL)^{2.98}$ was the most appropriate model among seven equations. Besides, based on r^2 values, length-length relationships (LLRs) by TL *vs.* SL was the finest model among six equations. These findings will help for species identification and further stock/ biomass estimation of *C. punctata* in the Gajner *Beel* or connected ecosystems.

[**Keywords**: *Channa punctata*, Gajner *Beel*, Meristic, Morphometric, Wetland ecosystem]

Introduction

The Spotted snakehead, *Channa punctata* (Bloch, 1793) is a brackish, freshwater, benthopelagic and potamodromous fish[1] belonging to the family of Channidae[2]. In Bangladesh, it is locally known as Taki. Additionally, this fish is known as Lati or Lata in India, Nga-thilon in Myanmar, Spotted snakehead in Sri Lanka and Garai in Nepal[3]. The *C. punctata* is renowned in Indian subcontinent and surrounding areas ranging across Afghanistan, India, Myanmar, Bangladesh, Nepal, Pakistan, Sri Lanka and Tibet[3]. It is widely abundant in ponds, ditches, *beels*, and swamps[2]. Additionally, adult *C. punctata* favors stagnant waters in muddy streams[4].

This species is a commercially important target fish for modest fishers in Bangladesh, and other parts of Asia, who use various traditional fishing gears[2]. *C. punctata* is a fast growing fish with voracious feeding habits, mainly feeds on tiny fish and fry[2]. It is a conventional food fish and has high consumer preference due to the absence of intramuscularly bones, less fat and high protein content in comparison to other commercial species like carps[5]. This species has a high market price and also has great survivability in adverse situation[6]. This species is listed as least concern both in Bangladesh[7] and in worldwide[8].

Morphometric is a technique used for narrating body form by assessing the length or distance between physical characteristics and landmarks[9]. On the other hand, meristic is an area of ichthyology, which relates to count quantitative features of fish, such as the number of fins or scales. Additionally, studies on morphometric and meristic features can be constructive tools for exact identification of any species and its classification[10-12]. Moreover, in fisheries study, the life history assessment, in addition to individual's well-being and the evaluation of the morphological traits of different populations are highly dependent on morphological characteristics[13-15]. To the best of the author's knowledge, very few studies have been done on the morphometric and

meristic traits of this fish. However, some attempts were made on LLRs and LWRs of this fish species[16-20]. Therefore, the current study has been undertaken to demonstrate the morphometric characteristics and meristic counts of *C. punctata* inhabiting the Gajner *Beel,* a wetland ecosystem from NW Bangladesh using multi-linear dimensions.

Material and Methods

Our research was performed in the Gajner *Beel*, a wetland ecosystem of northwestern Bangladesh (Latitude: 23°54′ N; Longitude: 89°52′ E) from July 2017 to December 2018. A total 307 individuals of *C. punctata* were collected through different fishing gears (cast net, gill net and square lift net with mesh size varied from: 1.50-2.00 cm, 1.50-2.50 cm, & ~2.00 cm, respectively). At once samples were instantly chilled in ice and stored in the laboratory with 10 % buffered formalin, where all morphometric and meristic characteristics were calculated[15]. Fin rays were counted by a magnifying glass. Digital electronic balance was also used to take individual body weight to the nearest 0.01 g accuracy. Different linear dimensions i.e., lengths such as total length (TL), standard length (SL), predorsal length (PrDL) etc. (See Fig. 1) were taken by measuring board to 0.01 cm accuracy.

The morphometric relationships between body length and weight were estimated as $W = a \times L^b$, where W means the body weight (g) and L means the various lengths (e.g., TL, SL etc.) in cm. The *a* and *b* (regression parameters) were calculated by this equation: $(W) = \ln(a) + b \ln(L)$. Furthermore, 95 % CL (confidence limit) of *a, b* and the coefficient of determination (r^2) were estimated. In addition, t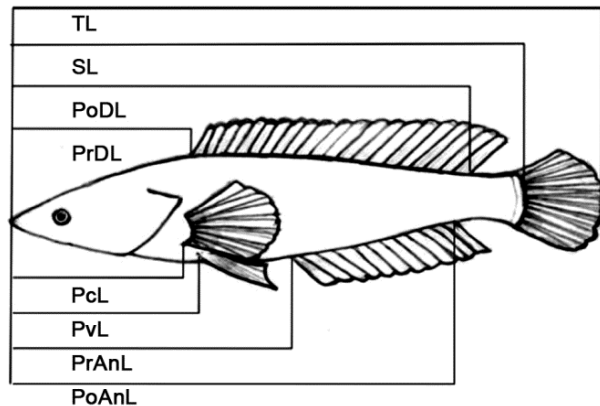o verifying the dissimilarity of *b* values that attained in the linear regressions a t-test was used[21]. In this study, length-length relationships were analyzed by linear regression analysis[4]. The most appropriate fitted model for both LWRs and LLRs was selected by the highest value of r^2. All the statistical analyses (considering 5 % significant level) were done by using the GraphPad Prism 6.5 software tool.

Results

The body shape of *C. punctata* is elongated and impartially rounded. Eyes are moderate with diameter 7.0 to 8.5 times of head length. Mouth is large with villi-form teeth on jaws. Pectoral fin is extending to anal fin and pelvic fin about 75 % of pectoral fin length. Caudal fin is curved. Large plate-like scale on head with 40-41 scales on lateral line was present. Body color is white to pale yellow on ventral side and black to light green on dorsal side (Fig. 2).

The fin formula of *C. punctata* was: D. 30–32; P_1. 15-17; P_2. 5; A. 19-21; C. (ii-iv/12-14) (Table 1; Fig. 3) and the TL was diverse from 5.80-23.00 cm (mean±SD = 14±3.17) and BW was ranged from 1.96-126.17 g (36.25 ±23.31) (Table 2).

Parameters *a* and *b*, 95 % CL and r^2 for LWRs of *C. punctata* are showed in Table 3. LWRs were highly significant ($p < 0.001$) with r^2 values ≥ 0.986. According to r^2 value, BW *vs.* TL was the most appropriate model among seven equations. The length-length relationships which are shown in Table 4 and all relationships were also highly correlated with r^2 values ≥ 0.992. On the basis of

Fig. 2 — A Photo of *Channa punctata* harvested from the Gajner *Beel*, NW Bangladesh

Table 1 — Meristic counts of *Channa punctata* (*n* = 307) captured from the Gajner *Beel*, NW Bangladesh

Meristic data	Numbers	(Un-branched / Branched)
Dorsal fin rays	30-32	
Pectoral fin rays	15-17	
Pelvic fin rays	5	
Anal fin rays	19-21	
Caudal fin rays	14-18	(ii-iv/12-14)

Unbranched, single fin ray; Branched, upper portion of fin is divided into several rays

Fig. 1 — Showing the morphometric measurement of *Channa punctata* from the Gajner *Beel*, NW Bangladesh
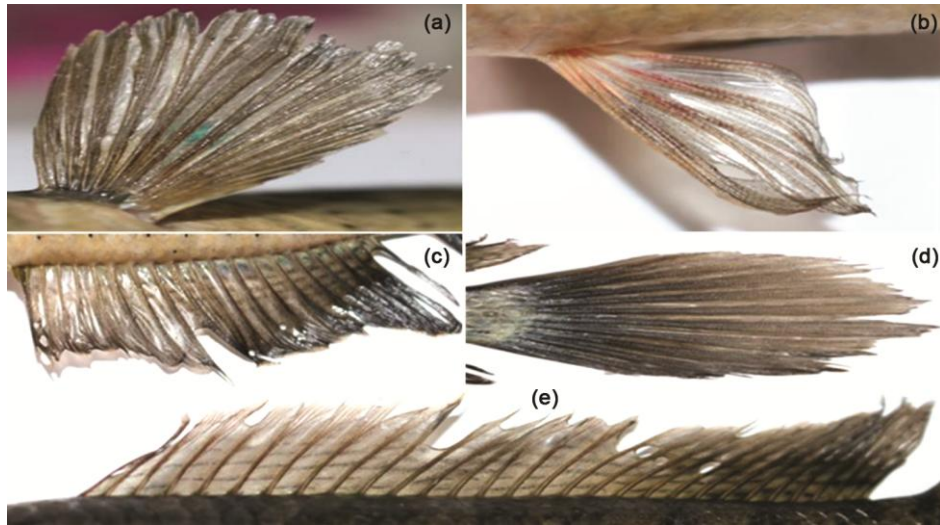
Fig. 3 — Different fins such as (a) Pectoral, (b) Pelvic, (c) Anal, (d) Caudal and (e) Dorsal fin of *Channa punctata* from the Gajner *Beel*, NW Bangladesh

Table 2 — Morphometric measurements of the *Channa punctata* (*n* = 307) captured from the Gajner *Beel*, NW Bangladesh

Measurements)	Min (cm)	Max (cm)	Mode (cm)	Mean ± SD (cm)	95 % CL (cm)	% TL
TL (Total length)	5.80	23.0	15.00	14.28±3.17	13.92 to 14.63	-
SL (Standard length)	4.50	18.60	12.00	11.78±2.62	11.48 to 12.07	80.86
PrDL (Pre-dorsal length)	2.00	6.90	4.50	4.30±0.93	4.19 to 4.40	30.00
PoDL (Post-dorsal length)	4.40	17.10	11.50	10.72±2.38	10.5 to 10.99	74.34
PcL (Pectoral length)	1.90	6.50	3.80	4.06±0.91	3.95 to 4.16	28.26
PrAnL (Pre-anal length)	2.90	9.70	6.00	6.30±1.35	6.15 to 6.46	42.17
PoAnL (Post-anal length)	4.10	16.60	11.00	10.56±2.36	10.29 to 10.83	72.17
BW (Body weight)*	1.96	126.90	6.39	36.25±23.31	33.63 to 38.88	551.73

Min- minimum; Max- maximum; SD- standard deviation; CL- confidence limit for mean values; TL- total length; *BW in g

Table 3 — Descriptive statistics and estimated parameters of the length-weight relationships of *Channa punctata* (*n* = 307) captured from the Gajner *Beel*, NW Bangladesh

Equation	Regression parameter		95 % CL of *a*	95 % CL of *b*	r^2
	a	*b*			
$BW = a*TL^b$	0.0112	2.98	0.0101 to 0.0124	2.946 to 3.024	0.986
$BW = a*SL^b$	0.0215	2.95	0.0192 to 0.0241	2.908 to 3.001	0.980
$BW = a*PrDL^b$	0.3634	3.05	0.3269 to 0.4041	2.980 to 3.126	0.956
$BW = PoDL*^b$	0.0268	2.97	0.0240 to 0.0299	2.932 to 3.025	0.981
$BW = a*PcL^b$	0.5047	2.94	0.4584 to 0.556	2.879 to 3.017	0.9581
$BW = a*PrAnL^b$	0.1048	3.09	0.0931 to 0.1179	3.030 to 3.159	0.966
$BW = a*PoDL^b$	0.0303	2.941	0.0272 to 0.0338	2.899 to 2.991	0.981

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

maximum r^2 value, LLR by TL *vs.* SL was the best fitted model among six equations.

Discussion

There are very few studies on morphometric (LWR and LLR) and meristic characters of *C. punctata*[2,4,18-20]. In the present study, the observed fin formula was dorsal fin, D. 30–32; pectoral fin, P₁. 15-17; pelvic fin, P₂.5; anal, A. 19-21; and caudal fin, C. (ii -iv/12-14), which was similar with the earlier studies[2,4].

A total of 307 individuals collected for the present study comprised various body sizes (5.80 – 23.00 cm). However, during this study, the absence of *C. punctata* smaller than 5.80 cm TL may be ascribed as because of poor market price of small fishes the fishers did not harvest the smaller sizes or due to the selectivity of fishing gears[16,22,23]. In our study, the

Table 4 — The estimated parameters of the length-length relationships ($y = a + b \times x$) *Channa punctata* ($n = 307$) captured from the Gajner *Beel*, NW Bangladesh

Equation	Regression parameters		95 % CL of *a*	95 % Cl of *b*	r^2
	a	*b*			
TL = a+b*SL	0.0771	1.20	-0.0678 to 0.2221	1.1935 to 1.2175	0.992
TL = a+b*PrDL	-0.1034	3.34	-0.4334 to 0.2264	3.2675 to 3.4174	0.961
TL = a+b*PoDL	0.0837	1.32	-0.1004 to 0.2680	1.3067 to 1.3402	0.987
TL = a+b*PcL	0.3935	3.41	0.0804 to 0.7066	3.3444 to 3.4951	0.963
TL = a+b*PrAnL	-0.3036	2.31	-0.5805 to - 0.0266	2.2691 to 2.3550	0.973
TL = a+b*PoDL	0.2075	1.33	-0.0010 to 0.4160	1.3126 to 1.3511	0.983

n- sample size; *a*- intercept; *b*- slope; CI- confidence intervals; r^2- co-efficient of determination

maximum length was 23.00 cm TL, which is quite similar with Medi *Beel*, Netrokona[18] (TL = 24.00 cm) but dissimilar with the findings observed in Tangail, River Brahmaputra[19] (TL = 27.00 cm) and in India[20] (TL = 32.40 cm). Indeed, maximum length is a helpful tool to estimate the growth parameters, and thereby important in fisheries resource planning and management[24-26].

In this study, the allometric coefficient, *b* value was 2.98, which indicated as an isometric growth pattern. The *b* values of LWRs ranging from 2.50 to 3.50 are more general[4] and our value is within the range. Generally *b* values close to 3, indicate that fish grow isometrically and it different from 3.0 indicate allometric growth (> 3 positive allometry and < 3 negative allometry)[26-27]. Some previous researches have been reported that the *b* value was 2.72 and 3.04 at Western Ghats Rivers of Tamil Nadu[15] and at Mathabhanga River, southwestern Bangladesh[16], respectively. However, the value of *b* may vary within the same species because of the involvement of one or more factors, the increase in different parts of the body, the gender, the physiology, the method of preservation and the difference in the observed length ranges from the collected samples[12,26-29]. Also, all LLRs were highly correlated, which is similar to an earlier study[30]. The current study contributes to the baseline of biological information, which is responsible for developing management strategies for fisheries and conservation of *C. punctata* population in the Gajner *Beel*, a larger wetland ecosystem and surrounding areas.

Acknowledgements

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

Author Contributions

ZM, MRH, and MYH: Conceive the concept of the review. MAI, MAR, AAC and MAR: Collect and analyzed the data. DK and OR: Software analyzed. MAI, ST, ZM, HUH and MRH: Wrote and edit the manuscript. JO: Reviewed the manuscript.

References

1 Riede K, *Global register of migratory species - from global to regional scales*, Final report of the R & D-Projekt 808 05 081, (Federal agency for nature conservation, Bonn, Germany), 2004, pp. 329.

2 Rahman A K A, *Freshwater fishes of Bangladesh. Zoological Society of Bangladesh*, (Department of Zoology, University of Dhaka), 1989, pp. 68-69.

3 Froese R & Pauly D, (Eds.) *FishBase*, World Wide Web electronic publication. Available at: http://www.fishbase.org (2018) (accessed on 21 October 2018).

4 Talwar P K & Jhingran A G, *Inland fishes of India and adjacent countries*, Vol 2, (A A Balkema, Rotterdam), 1991, pp. 1021.

5 Ling S W, *Aquaculture in Southeast Asia*: *a historical overview*, Seattle, (University of Washington press), 1977, pp. 108.

6 Dars B A, Narejo N T & Awar K P, Morphometric, meristic characters and their relationships *Channa punctata* (Bloch,1973) from River Indus near Jamshoro Sindh, Pakistan, *Sindh Univ Res Jour (Sci Ser)*, 44 (1) (2012) 91–96.

7 IUCN Bangladesh, Red list of Bangladesh, Vol 5, *Freshwater fishes*, (IUCN, International union for conservation of nature, Bangladesh country office, Dhaka, Bangladesh), 2015, pp. xvi+360.

8 IUCN, *Redlist of threatened species*, version 2017-1, downloaded on (3 September 2018).

9 Muchlisin Z A, Morphometric variations of Rasbora Group (Pisces: Cyprinidae) in Lake Laut Tawar, Aceh Province, Indonesia, based on truss character analysis, *Hayati J Biosci*, 20 (2013) 138–143.

10 Bagenal J B & Tesch F W, *Methods for assessment of fish production in freshwaters*, (Blackwell Scientific publication, Oxford), 1978, pp. 361.

11 Jayaram K C, *The Freshwater Fishes of the Indian Region*, (Narendra Publishing House, Delhi), 1999, pp. 551.

12 Hossen M A, Hossain M Y, Pramanik M N U, Nawer F, Khatun D, *et al.*, Morphological Characters of *Botia lohachata*, *J Coast Life Med*, 4 (2016) 689–692.

13 King M, *Fisheries Biology, Assessment and Management*, 2nd edn, (Oxford Press, London), 2007, pp. 382.

14 Hossain M Y, 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 Sc*, 10 (2010) 131–134.

15 Hossain M Y, Rahman M M, Abdallah E M & Ohtomi J, Biometric relationships of the Pool barb *Puntius sophore* (Hamilton 1822) (Cyprinidae) from three major rivers of Bangladesh, *Sains Malays*, 22 (2013) 1571–1580.

16 Hossain M Y, Rahman M M, Fulanda B, Jewel M A S, Ahamed F, *et al*., Length-weight and length-length relationships of five threatened fishes from the Jamuna (Brahmaputra River distributary) River, northern Bangladesh, *J Appl Ichthyol*, 28 (2012) 275–277.

17 Hossain MY, Ahmed Z F, Leunda P M, Islam A K M R, Jasmine S, *et al.,* Length-weight and length-length relationships of some small indigenous fish species from the Mathabhanga River, southwestern Bangladesh, *J Appl Ichthyol*, 22 (2006a) 301–303.

18 Mustafa M G & de Graaf G, Population parameters of important species in inland fisheries of Bangladesh, *Asian Fish Sci*, 21 (2008) 147–158.

19 De Graaf G, The flood pulse and growth of floodplain fish in Bangladesh, *Fish Manag and Ecol*, 10 (2003) 241-247.

20 Qasim S Z & Bhatt V S, The growth of the Freshwater murrel, *Ophicephalus punctatus*, *Hydrobiologia*, 36 (1966) 165–177.

21 Hossain M Y, Ahmed Z M, Leunda P M, Islam A K M R, Jasmine S, *et al*., Length-weight and length-length relationships of some small indigenous fish species from the Mathabhanga River, southwestern Bangladesh, *J Appl Ichthyol*, 22 (2006b) 301–303.

22 Hossain M Y, Rahman M M, Bahkali A H, Yahya K, Arefin M S, *et al*., Temporal variations of sex ratio, length-weight relationships and condition factor of *Cabdio morar* (Cyprinidae) in the Jamuna (Brahmaputra River distributary) River, Northern Bangladesh, *Pakistan J Zool*, 48 (2016a) 1099–107.

23 Hossain M Y, Hossen M A, Khatun D, Nawer F, Parvin M F, *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*, 10 (2017) 57–62.

24 Ahmed Z F, Hossain M Y & Ohtomi J, Modeling the growth of silver hatchet chela *Chela cachius* (Cyprinidae) from the Old Brahmaputra River in Bangladesh using multiple functions, *Zool Stud*, 51 (2012) 336–344.

25 Hossain M Y, Hossen M A, Pramanik M N U, Ahmed Z F, Hossain M A, *et al*., Length–weight and length–length relationships of three Ambassid fishes from the Ganges River (NW Bangladesh), *J Appl Ichthyol*, 32 (2016b) 1279–1281.

26 Rahman M A, Islam M S, Hossain M Y, Hasan M R, Islam MA, *et al*., Morphometric and meristic characteristics of the Banded Gourami, *Trichogaster fasciata* (Bloch & Schneider, 1801) in a wetland ecosystem from northwestern Bangladesh, *Jordan J Biol Sci*, 11 (2019) 561 – 566.

27 Tesch F W, Age and growth, In: *Methods for assessment of fish production in fresh waters*, edited by W E Ricker, (Blackwell Scientific Publications, Oxford), 1971, pp. 99-13.

28 Hossain M Y, Sayed S R M, Rahman M M, Ali M M, Hossen M A, *et al*., Length-weight relationships of nine fish species from the Tetulia River, southern Bangladesh, *J Appl Ichthyol*, 31 (2015) 967–969.

29 Nawer F, Hossain M Y, Hossen M A, Khatun D, Parvin M F, *et al*., 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 (2017) 199–203.

30 Hossain M Y, Ahmed Z F, Leunda P M, Jasmine S, Oscoz J, *et al*., 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 (2006c) 304–307.