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Note

Biometric studies of *Ailia coila* (Hamilton, 1822) from river Brahmaputra, Assam, India

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ABSTRACT

For the study of length-weight relationship, morphometric and meristic characters, a total of 711 specimens (196 male and 515 female) of the Gangetic ailia, *Ailia coila* (Hamilton, 1822) were collected from Uzanbazar and Dhubri landing centres of river Brahmaputra, Assam during September 2013 to April 2014. The length and weight of males ranged from 66 to 154 mm and 1.21 to 20.53 respectively and that of females ranged from 66 to 161 mm and 1.43 to 18.29 g respectively. The length-weight relationship was established as $W = 0.002773\ L^{3.18}$ and $W = 0.005794^{2.86}$ for male and female, respectively. The analysis of covariance showed significant difference in 'b' values between sexes and student 't' test indicated positive allometric growth for male and isometric growth for female. The morphometric characters were compared; showed maximum co-efficient of correlation (r) in standard and pre-dorsal length (0.98) while lowest was observed in mandibular barbel length (0.69) against the total length. Based on the study of meristic traits, the fin formula can be written as B_6, P_{12-15}, V_{5-6}, C_{14-18}, A_{61-75}, GR_{17-24}. The minor variations in meristic and morphometric characters could be attributed to genetic components and difference in geographical and environmental parameters like temperature and food availability. Results of the study would help in identification of stock and stock specific management strategies of this species in river Brahmaputra, Assam.

Keywords: *Ailia coila,* Brahmaputra, Length-weight relationship, Meristic, Morphometric

Morphometric and meristic characters play very important role in taxonomic identification for any species. For any method of classification employed, these characters are needed to differentiate taxa and assess their inter-relationships. Meristic characters include the number of fin rays, spines, gill rakers, scales, branchiostegal rays, scutes and vertebrae. However, these counts may differ in their different environmental conditions during their early development period for the same species (Colman, 1976). The knowledge of length-weight relationship of fish is of vital importance in fishery science as it is utilised for stock assessment studies and for knowing the well being of the fish (condition factor). Like morphometric characters, the length-weight relationship also can be used for the differentiation of taxonomic unit, because it changes with various developmental events in life such as metamorphosis, growth and the onset of maturity (Thomas *et al.,* 2003). The length-weight data is a basic parameter for growth monitoring study in fishes, since it provides important information concerning the structure and function of the populations (Anderson and Neumann, 1996). Many workers have studied the length-weight relationship of species under the family Schilbeidae from Indian freshwaters as well as other countries. Some of them include Vinci (1984) on *Silonia childreni* from Nagarjunasagar Reservoir; Konan *et al.* (2007) on three schilbeid catfishes *viz*., *Parailia pellucida, Schilbe intermedius* and *Schilbe mandibularis* from Ivory coast; Hart and Abowei (2007) and Abowei (2009) on *P. pellucida* from lower Nun River, Nigeria; Hussain *et al.* (2008) on *Clupisoma naziri* from Indus River, Pakistan; Hossain (2009; 2010) on *Ailia coila* from Ganges and Padma rivers, Bangladesh; Prasad *et al.* (2012) on *Horabagrus brachysoma* from Periyar River, South Western Ghats and Sarkar *et al.* (2013) on *Clupisoma garua* from Ganga, Gomti and Tapti rivers.

The Gangetic ailia *Ailia coila* (Hamilton, 1822) belonging to the family Schilbeidae (Order: Siluriformes) forms important diet for the people of Assam and fetches

high price. It is locally known as '*Kajoli'* or *'Bahpati'* in Assamese and contributes a major catch among catfishes in Brahmaputra River. It is a surface to mid water fish, commonly found in shoals. The maximum size recorded is 300 mm with common size of 180 mm in the landings (Talwar and Jhingran, 1991). Although, this high priced medium sized cat fish contributes a substantial amount in the total catch, so far no attempt has been made to study the morphometry, meristic and length-weight relationship of this species from Brahmaputra River. Thus, it was felt that this study would be helpful in identification of stock and probably lead the way to conservation and management of this species in river Brahmaputra, Assam.

For the study of morphometric and meristic characters, a total of 202 specimens of *A. coila* were collected during September, 2013 to April, 2014 from Uzanbazar, Guwahati (26º11′43.25″ N; 91º45′20.90″ E) and Dhubri landing centre, Dhubri (26º01′23.62″ N; 89º59′31.72″ E) of Brahmaputra River in Assam at weekly and fortnightly intervals respectively. Morphometric characters (in mm), meristic counts (in nos.) and length-weight measurements (in cm and g) were recorded in fresh condition in the laboratory as described by Lagler *et al.* (1962), Laevastu (1965) and Lowe-Mc Connel (1971). The morphometric characters measured were: total length (TL), standard length (SL), fork length (FL), pre-dorsal length (PDL), pre-anal length (PAL), pre-pelvic length (PPL), pre-pectoral length (PPL), head length (HL), body depth (BD), caudal fin base (CFB), pectoral fin length (PFL), caudal fin length (CFL), anal fin base (AFB), maxillary (MBL), nasal (NBL) and mandibular barbel length, outer and inner MBL (O & I), mouth width (MW), snout length (SNL), inter-orbital length (IOL), post-orbital length (POL) and eye diameter (ED). Meristic characters included for the study were number of spines and rays in pectoral fin, pelvic fin, anal fin, caudal fin, gill rakers on first gill arch and branchiostegal rays. The length ranged from 89.3-158.26 mm and weight from 2.76-1.20 g.

Relationships between the various body measurements to the total length and head length were established. Scattergram of morphometric characters were plotted and linear regression equation was fitted using least square method described by Laevastu (1965) and Snedecor and Cochran (1967) as: Y = a + bx in the usual notations.

Study of length-weight relationship was based on 196 males and 515 females in the size range of 66 -154 mm and 66 -161 mm weighing 1.21-20.53 g and 1.43-18.29 g respectively. The length-weight relationship was established separately for male and female using the formula by Le Cren (1951): $W = a L^b$, which takes the shape of log W = log a + b log L. The coefficient of correlation 'r' was determined for male and female separately to know the relationship between the two variables. The analysis of covariance was computed to know the variation in 'b' values among the sexes at 1% and 5% level of significance by following Snedecor and Cochran (1967). The student's t-test was employed to predict any significant deviation of the 'b' value from 3:

$$t = (b-3)/ S_b$$

where, S_b = Standard error of 'b' = $S_b = \sqrt{(1/ (n-2))*[(S_y/ S_x)^2 - b^2]}$

S_x and S_y are standard deviations of 'x' and 'y' respectively. The t-value was compared with t-table value for (n-2) degrees of freedom at 1 and 5% level of significance.

Results on various morphometric characters, their range, mean, median, standard error, standard deviation and co-efficient of variation are depicted in Table 1. Maximum coefficient of variation was found in MW (19.95%), while ED (11.49%) showed the lowest co-efficient of variation. Results revealed, the degree of correlation between compared morphometric characters that ranged from 0.49-0.98. SL and PDL showed maximum degree of correlation (0.98) with TL, while MBL showed minimum correlation (0.69). The coefficient of correlation of HL against compared characters ranged from 0.49 (MW) to 0.82 (POL). Correlation between CFB against BD was found to be 0.58. The 'b' values indicated highest growth in FL (0.88) followed by SL (0.85) and AFB (0.50) in relation to per unit growth of TL while POL was found to have highest 'b' value (0.49) in relation to per unit growth of HL. On the other hand, the lowest growth rate was obtained in HL (0.10) to per unit change of TL. BD in relation to TL and CFB in relation to per unit change in BD showed slow growth rate for the species. The scattergram for the relationships of the above mentioned morphometric characters are presented in Fig. 1 and 2.

Information on the biological aspects of schilbeid catfish is relatively less from river Brahmaputra in Assam. Pioneer work on morphometric relationship among TL, FL and SL for three Schilbeid catfish [*A. coila, Eutropiichthys vacha* and *Neotropius* (=*Pachypterus*) *atherinoides*] was done by Hossain (2010) from Padma River, north-western Bangladesh, where length-weight relationships are reported to be highly significant ($p<0.01$), with most of the coefficient of determination (r^2) values >0.89. The present study showed almost similar results to

Table 1. Statistical estimates of various morphometric characters in *A. coila*

Statistical estimates	Range (mm)		Mean	Median	Standard Error	Standard Deviation	Coefficient of Variation (%)
	Min	Max	(mm)	(mm)			
TL	80.77	158.26	121.09	117.88	1.15	16.38	13.52
FL	78.54	140.17	107.6	105.42	1.04	14.81	13.76
SL	72.05	136.51	101.02	99.17	1.00	14.33	14.18
PDL	59.82	108.95	83.14	81.35	0.83	11.91	14.32
PAL	20.93	45.2	32.19	31.61	0.33	4.79	14.88
PPL	13.36	25.71	18.12	17.77	0.17	2.43	13.41
PVL	18.26	37.85	27.27	26.99	0.28	4.03	14.77
AFB	39.97	79.86	59.35	58.53	0.63	9.02	15.19
PFL	11.65	23.19	16.11	15.75	0.16	2.35	14.58
CFL	13.15	31.17	20.05	19.87	0.2	2.86	14.26
CFB	6.63	22.67	9.65	9.46	0.13	1.92	19.89
HL	12.73	22.37	15.53	16.2	0.13	1.98	12.74
BD	12.16	29.11	19.28	19.31	0.2	2.92	15.14
SNL	3.87	7.15	5.39	5.38	0.04	0.68	12.61
IOL	4.38	10.94	7.1	7.07	0.07	1.11	15.63
POL	4.63	11.18	7.78	7.75	0.08	1.19	15.29
ED	3.14	6.06	4.35	4.28	0.03	0.5	11.49
MW	2.25	7.2	4.21	4.2	0.05	0.84	19.95
NBL	32.31	80.14	51.61	51.07	0.58	8.27	16.02
MBL	35.84	83.59	53.46	52.46	0.59	8.52	15.93
MBL (O)	28.24	73.79	47.1	47.7	0.63	8.95	19.00
MBL (I)	26.96	72.48	46.03	46.82	0.61	8.75	19.00

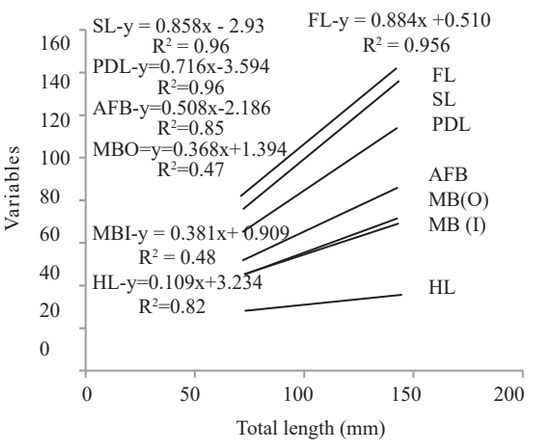

Fig. 1. Scattergram of total length against SL, FL, PDL, AFB, MB (O and I) and HL of *A. coila*

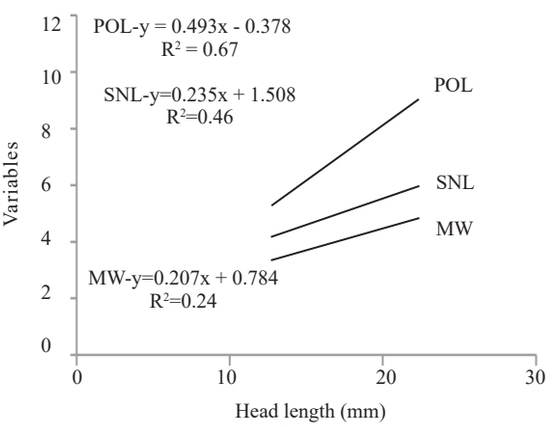

Fig. 2. Scattergram of head length against POL, SNL and MW of *A. coila*

these morphometric characters but other morphometric characters were found to have some minor variations. These variations may be attributed to the differences in ecological conditions of the habitat (AnvariFar *et al.,* 2011; Khan and Nazir, 2018) or variations (AnvariFar *et al.,* 2011; Khan and Nazir, 2018) or variations in the physiology of animals or both (Le Cren, 1951). Khan and Nazir (2018) studying on *Sperata aor* from river Ganga stated that the differences of morphomtric variations were due to differences in environmental factors, mainly water chemistry, turbidity and water colouration of the study sites.

The results of statistical analysis on various meristic characters are shown in Table 2. The analysis indicated that the species possesses 12-15 pectoral fin rays, 5-6 ventral fin rays, 61-75 anal fin rays, 14-18 caudal fin rays

and 6 branchiostegal rays. The number of gill rakers on their first gill arch of left side varied from 17-24.The coefficient of variation was found to be the highest for gill rakers (11%) and lowest for pectoral fin rays (5.3%). On the basis of the above observation, the fin formula for *A. coila* could be written as: $B_{6}\ P_{12\text{-}15} V_{5\text{-}6}\ C_{14\text{-}18}\ A_{61\text{-}75}$, $GR_{17\text{-}24}$.

The meristic counts showed resemblance with the earlier studies (Day, 1878; Talwar and Jhingran, 1991). Present study revealed minor variation in anal fin rays that ranged from 61 to 75. This minor variation recorded in the meristic counts could be a result of genetic components (Heincke, 1898; Giery *et al.,* 2015; Khan and Nazir, 2018) or environmental parameters like temperature and food availability (Takahashi and Koblmuller, 2011).

The length-weight relationship was established as: $W = 0.002773\ L^{3.189}$ for male and $W = 0.005794\ L^{2.86}$ for female. The scattergram of power relationship are depicted separately for males and females (Fig. 3a, b). The analysis of co-variance showed significant variation ($p<0.01$) in 'b' values between the sexes. The Student 't'test was performed separately for both sexes to test whether the length-weight relationship follows isometric growth pattern. The calculated t-value was found to be significant for both the sexes at 1 and 5% level, indicating positive allometric growth for male and isometric growth for female.

The earlier investigations on length-weight relationship of this species and other species under this family were carried out from different locations. The authors have reported both isometric and allometric growth patterns in their respective studies (Table 3). The value of regression coefficient obtained in the present study showed minor variation from the values reported for *A. coila* (3.076) from Padma River (Hossain, 2010). A species of the same family *N.* (=*P.*) *atherinoides* had 'b' value of 2.899 (Hossain, 2010), while the values reported for other species under this family showing resemblance with the present study are that of Sarkar *et al.* (2013) for *C. garua* (b= 2.53) and Soomro *et al.* (2007) for *E. vacha* (b= 3.159 for male; b=2.958 for female). Similar results were reported for males of *H. brachysoma* (b=3.072 for male and 3.172 for female) from Periyar River, south Western Ghats (Prasad *et al.,* 2012).

The coefficient of regression 'b' obtained for female in the present study is below 3.0 which indicated that the rate of increase in body weight is not in proportion to the rate of increase in length. This change may be because of various factors which affect the growth of fish, including season, habitat, gonadal maturity, sex, fullness of stomach, health and preservation techniques (Tesch, 1971; Bagenal and Tesch, 1978). The 'b' value obtained in the present study for male LWR was >3 which indicates that the male of *A. coila* grows as the cube of length. Difference in values of exponent 'b' for *A. coila* reported by other workers could be attributed to geographical and ecological differences which led to variations in water quality parameters as well as food availability thereby affecting growth of fish (Mommsen, 1998; Panda *et al.,* 2016). Sparret *et al.* (1989) documented that geographical variation has a close relation in respect of the values of regression co-efficient 'b'.

Since, this high valued catfish contributes a substantial amount to the total fish catch from river Brahmaputra, Assam it would be very much important to estimate the optimum mesh size including standardisation of fishing effort towards this fishery from the river which requires further investigations. Decline in catch of this species from 31,431 kg in 2007 to 11,084 kg in 2012 in this river (Gogoi, 2014), indicate an urgent necessity for management measures. The present investigation on length-weight relationship, morphometric and meristic traits provides baseline information on this species which would help in understanding the stock and further in formulating management strategies in river Brahmaputra, Assam.

Table 2. Statistical estimates of various meristic characters in *A. coila*

Meristic characters	Range (mm)		Mean	Median	Mode	Standard error	Standard deviation	Coefficient of variation (%)
	Min.	Max.						
Pectoral fin rays	12	15	13	14	14	0.04	0.7	5.384615
Ventral fin rays	5	6	5.52	6	6	0.03	0.5	9.057971
Anal fin rays	61	75	68	69	69	0.27	3.91	5.75
Caudal fin rays	14	18	16	16	16	0.07	1.12	7
Branchiostegal rays	6	6	6	6	6	0	0	0
Gill rakers	17	24	20	21	18	0.15	2.23	11.15

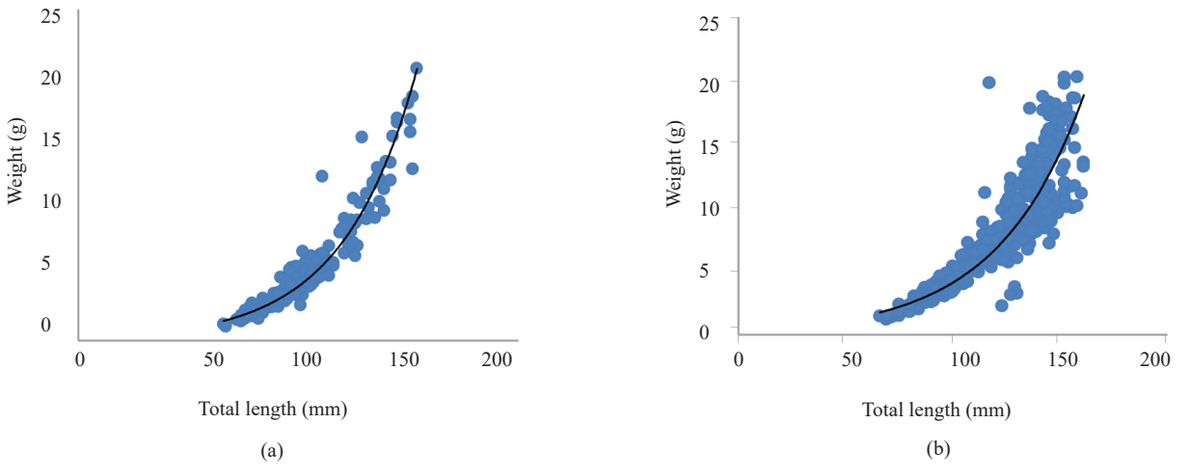

Fig 3. Length-weight relationship in *A. coila.* (a) Male, (b) Female

Table 3. Estimates of intercept (a), slope (b) and correlation co-efficient (r) for length weight relationship of *A. coila* reported from previous studies

Authors	Location	Sex	No. of observations	Intercept	Slope	r^2
S. childreni Vinci (1984)	Nagarjunasagar Reservoir	M	45	-5.0162	2.92	0.95
		F	107	-5.7272	3.20	0.97
	Combined sexes		152	-5.6141	3.13	0.96
E. vacha Soomro *et al.* (2007)	Indus River, Pakistan	M	142	0.0039	3.15	0.95
		F	128	0.0072	2.95	0.97
	Combined sexes		270	0.0054	3.05	0.96
P. pellucida Hart and Abowei (2007)	Lower Nun River, Niger Delta	-	-	0.0001	3.03	0.90
P. pellucida	Ivory Coast	-	129	0.001	3.72	0.91
S. intermedius		-	34	0.003	3.36	0.99
S. mandibularis Konan *et al.* (2007)		-	1844	0.006	3.08	0.91
C. naziri Hussain *et al.* (2008)	River Indus, Pakistan	-	-	- 3.88	4.19	0.36
P. pellucida Abowei (2009)	Lower Nun River, Niger Delta	-	-	0.0001	3.23	0.90
A. coila Hossain (2009)	Ganges, Bangladesh	-	-	0.008	3.01	0.98
A coila	Padma River, Bangladesh	-	105	0.089	3.07	0.98
E. vacha and		-	130	0.107	3.00	0.98
N. atherinodes Hossain (2010)		-	112	0.095	2.89	0.97
H. brachysoma	Periyar River, south	M	-	0.0093	3.07	0.92
Prasad *et al.* (2012)	Westeren Ghats, India	F	-	0.0079	3.17	0.96
	Combined sexes			0.0084	3.10	0.94
C. garua	River Ganga,	-	25	-3.32	2.53	0.98
Sarkar *et al.* (2013)	Gomti and	-	34	-5.34	2.41	0.98
	Tapti	-	50	-2.42	2.22	0.99
Present study (2014)	Brahmaputra River,	M	196	- 2.5570	3.18	0.93
	Assam	F	515	- 2.2370	2.86	0.88

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