Length-weight relationship, condition factor and relative growth patterns of *Channa punctata* (Bloch) from Himachal Pradesh, India

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Abstract

The length weight relationship, condition factor and relative growth patterns of *Channa punctata* (Bloch) were studied in different size groups of male and female. The values of b in length weight equations were found to be 2.804, 2.739, 2.803 and 2.863 for male, female, pooled and unsexed group respectively. Almost, all the values of condition factor (K) and relative condition factor (Kn) were found to be greater than '1' except few values of Kn, indicating the well being of fish in existing environment. The growth patterns of all the morphometric parameters inferred a linear relationship in respect of total length (TL) and head length (HL) which showed a positive correlation. The increase in a body parameter in relation to a unit increase in TL or HL was also analyzed in the present study.

Introduction

Channa punctata (Bloch, 1793) or the Green Head Spotted Murrel is a mud-dwelling fish with a snake head like appearance and a slimy cylindrical body. This is one among the most common group of air breathing fish which has good nutritive and medicinal qualities (Bhuyian 2006, Kappulakshmi 2008). This fish is very hardy in nature and qualifies all the desired attributes for the culture practices. A decade ago this fish was very common and abundant in many water bodies like wells, rivers, ponds, ditches and even in the irrigation canals. But due to increasing pollution and other anthropogenic activities this fish is vanishing rapidly. Thus it becomes necessary to conserve this species as it can be a candidate species for aquaculture practice in low lying areas of Himachal Pradesh. The mathematical relationship between length and weight of fish, condition factor (K) and relative growth patterns have a great significance with regard to their biology as well as help in stock assessment. Even though, length weight relationships *Channa punctata* have been studied by the different workers from different locations (Dhanze and Sen, 1992; Basgeer *et al.*, 1993; Sarkar, 1996 Ali *et al*., 2000; Haniffa *et al.,* 2006; Chandra *et al.*, 2010; Singh *et al*., 2011 and Dars *et al*., 2012), considering the aquaculture potential of this species, the present investigation was undertaken to study the length-weight relationship, condition factor and relative growth parameters of *Channa punctata* from Himachal Pradesh, India.

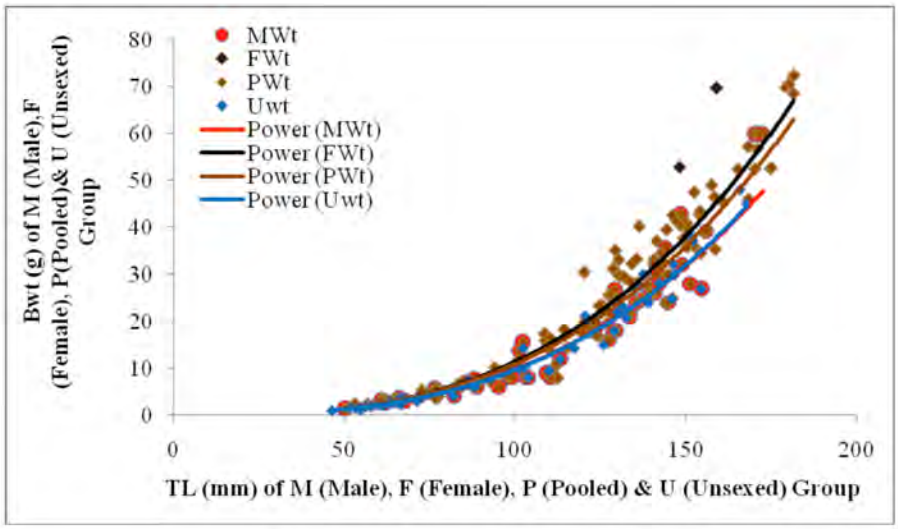

Fig. 1 Length weight relationships of Male, Female, Pooled and Unsexed Group

Table-1. The results of correlation regression analysis and 't' test

	N	n	L (mm)	Wt (g)	Regression Eq		r	Sb	t-value	95% CI of 'b'
			Min-max	Min-max	a	b				
M	48	6	40-160	2.80-59.98	-4.359	2.804	0.994	0.151	1.292	3.10-2.51
F	105	6	40-160	3.14-62.70	-4.283	2.792	0.998	0.064	3.23	2.92-2.67
P	153	6	30-170	3.04-61.88	-4.320	2.803	0.998	0.064	3.038	2.93-2.68
U	61	6	30-150	2.41-31.62	-4.438	2.863	0.990	0.196	0.697	3.25-2.48

M(Male), F(Female), P(Pooled) and U(Unsexed) group; N= No of Fish in a group ; n= no of classes in respective group, 'a' & 'b' are parameters of L-W-R relation or regression coefficients , r = correlation coefficient, Sb = standard error of 'b', 95% of CI= Confidence limits of b

Material and methods

A total of 214 specimens of fish were collected from sub-tributaries of river Beas in Himachal Pradesh at different reaches (Nagni, Sub-Tehsil-Thural and Tanda, Tehsil Palampur, District-Kangra) by using diverse gears like hooks and lines, cast net, hand net and some other local fishing traps during the period of January to December 2011. The collected specimens of this fish consisted of male, female, pooled (male, female) and unsexed group having 48, 105, 153 and 61 number of fish respectively. The measurements of fish were taken to nearest (0.1mm) and body weights up to (0.1 g) by using Vernier callipers and standard electronic balance respectively. In order to ascertain, the pattern of growth, standard well being, fatness and gonad development of the fish morphometric measurements and total weight were noticed to find out the variation from the expected weight for an individual fish with a specific length. The data of length weight relationship (LWR) were analyzed by following, LeCren's (1951) method, W=a Lb, which was transformed into linear equation by taking the logarithm of variables, log W = log a + b log L., where 'W' is the weight of the fish, 'L'

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Table-2. K and Kn Values for different size groups of Male (M) and Female (F)

Group		40-60	60-80	80-100	100-120	120-140	140-160
Male	A. wt	2.804	6.668	10.268	23.762	33.812	59.983
	Av. S.L.	49.444	71.803	88.113	110.991	125.94	147.373
	∧ W	2.466	7.03	12.48	23.87	36.48	52.93
	K	2.32	1.8	1.5	1.74	1.69	1.87
	Kn	1.14	0.95	0.82	1	0.93	1.13
Female	A. wt	3.148	6.437	16.392	26.47	38.468	62.7
	Av. S.L.	51.003	68.693	91.902	108.757	125.617	152.621
	∧ W	3.061	7.025	15.82	25.3	37.83	65.12
	K	2.37	1.99	2.11	2.06	1.94	1.76
	Kn	1.03	0.92	1.04	1.05	1.02	0.96

Table-3. Regression coefficients and correlation between X and Y of different groups.

Parameters		Male Group (n=48)				Female Group (n=105)			
x	y	a	b	r	R^2	a	b	r	R^2
TL	HL	-0.076	0.268	0.983	0.966	2.309	0.242	0.977	0.955
TL	BW	-0.754	0.133	0.902	0.813	-1.300	0.135	0.900	0.809
TL	BD	2.245	0.113	0.939	0.882	-0.489	0.143	0.950	0.903
TL	DFL	-1.324	0.110	0.909	0.826	-3.305	0.125	0.960	0.922
TL	PFL	1.279	0.140	0.939	0.882	1.472	0.132	0.898	0.807
TL	VFL	-0.527	0.072	0.939	0.882	-0.901	0.077	0.919	0.844
TL	AFL	-1.718	0.100	0.934	0.872	-2.934	0.107	0.916	0.839
TL	CFL	2.758	0.146	0.826	0.683	3.140	0.140	0.891	0.793
HL	HW	0.070	0.633	0.953	0.908	-2.770	0.743	0.961	0.923
HL	MW	-1.971	0.442	0.919	0.844	-5.253	0.585	0.931	0.867
HL	SntL	0.309	0.201	0.840	0.706	-0.628	0.221	0.901	0.812
HL	ED	0.844	0.146	0.739	0.546	-0.992	0.218	0.867	0.751

Parameters		Pooled Group (n=153)				Unsexed Group (n=61)			
x	y	a	b	r	R^2	a	b	r	R^2
TL	HL	1.486	0.250	0.975	0.950	-0.749	0.750	0.980	0.961
TL	BW	-1.495	0.134	0.903	0.815	0.366	0.119	0.973	0.947
TL	BD	0.366	0.136	0.930	0.864	-0.555	0.145	0.963	0.927
TL	DFL	-2.447	0.118	0.939	0.882	-0.560	0.096	0.947	0.896
TL	PFL	1.706	0.133	0.927	0.859	0.906	0.140	0.925	0.856
TL	VFL	-1.108	0.078	0.891	0.794	0.450	0.065	0.903	0.815
TL	AFL	-2.656	0.107	0.928	0.860	0.018	0.080	0.947	0.896
TL	CFL	2.710	0.143	0.844	0.712	2.879	0.138	0.915	0.837
HL	HW	-1.991	0.716	0.955	0.912	1.062	0.582	0.984	0.969
HL	MW	-4.111	0.539	0.927	0.858	-1.770	0.421	0.969	0.939
HL	SntL	-0.090	0.205	0.893	0.797	1.007	0.160	0.908	0.824
HL	ED	-0.347	0.195	0.833	0.694	0.785	0.151	0.852	0.725
HL	IOL	-1.600	0.198	0.785	0.615	0.159	0.140	0.793	0.629

is the Standard length and 'a' is initial growth index and 'b' is the regression coefficient. The t-test (Snedecor and Cochran, 1967) was employed to find out whether the b-value for different species were significantly different from '3' i.e. expected cubic value under isometry by using the formula, t=b-3/ sb, where sb=standard error of (b). The L-W-R in the present investigation was studied, taking into consideration the intact weight of fish i.e., including gut and gonad weight. Condition factor (K) for different size groups was derived using the formula K= W/L3 x 105, where K= co-efficient of condition and the value 105 is used to bring the value to unity. Relative condition factor (Kn) was studied for different size groups by following the LeCren (1951) equation (Kn=Wo/∧W) where Wo and ∧W were observed body weights and calculated body weights respectively. Different morphometric measurements were recorded and followed as per of Jayaram (1981). For relative growth studies, the fish (i.e., male, female, pooled and unsexed) groups were considered, and the relationship between various body parameters were represented by the least square equation Y = a + b X, where X = total length (TL) and head length (HL), Y=body parameters. The regression line was calculated by using the five summary statistics, $\bar{x}$ SDx, $\bar{y}$, SDy and r (i.e. the mean and standard deviation of X, the mean and standard deviation of Y, and the Pearson correlation between X and Y.).

The slope 'b' and intercept 'a' were calculated as

$b = r\frac{SDy}{SDx}$ and $a = \bar{y} - b\bar{x}$

respectively. The different body parameters accessed for relative growth patterns were head length (HL), body width (BW), body depth (BD), dorsal fin length (DFL), pectoral fin length (PFL), ventral fin length (VFL), anal fin length (AFL), caudal fin length (CFL), head width (HW), mouth width (MW), snout length (SntL), eye diameter (ED) and inter-orbital length (IOL). Moreover prior to various measurements sex and gonad maturity were also observed during the study. The data obtained from these morphometric measurements was accessed statistically for correlation and regression coefficients using Microsoft Office Excel 2007®.

Results

Channa punctata of average length ranging between 30 mm to 170 mm and body weight 2 g to 66 g were analyzed to obtain the L-W-R equations. The 'b' value 2.804 (t= 1.292, df=5, P>0.5) and 2.863 (t=0.697, df=5, P>0.5) for male and unsexed group showed no significant differences and revelled an isometric growth pattern. While, in case of female and pooled groups non-isometric growth patterns were found as indicated by b value 2.792 (t=3.23,

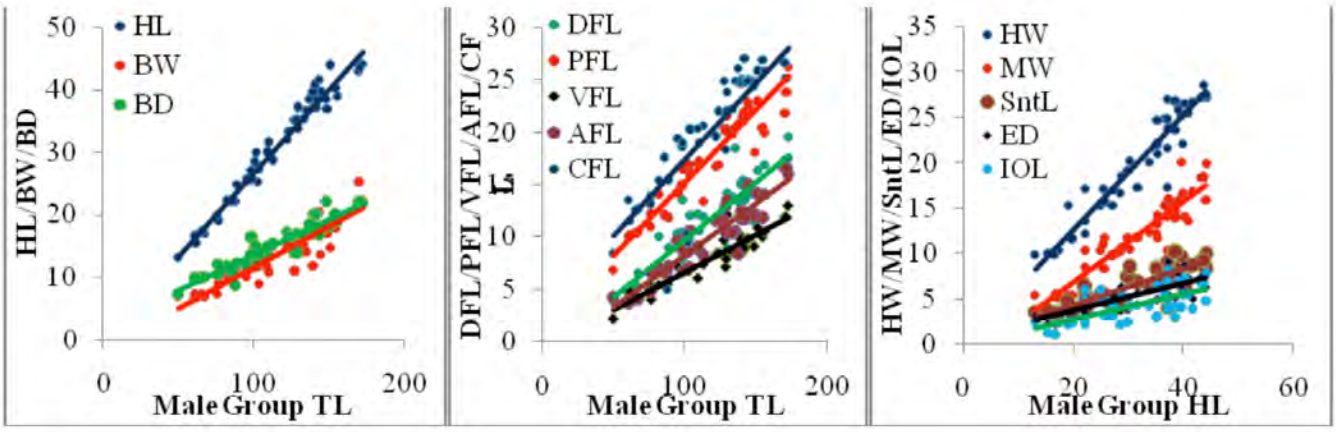

Fig. 2. Relative Growth Patterns of Male Group

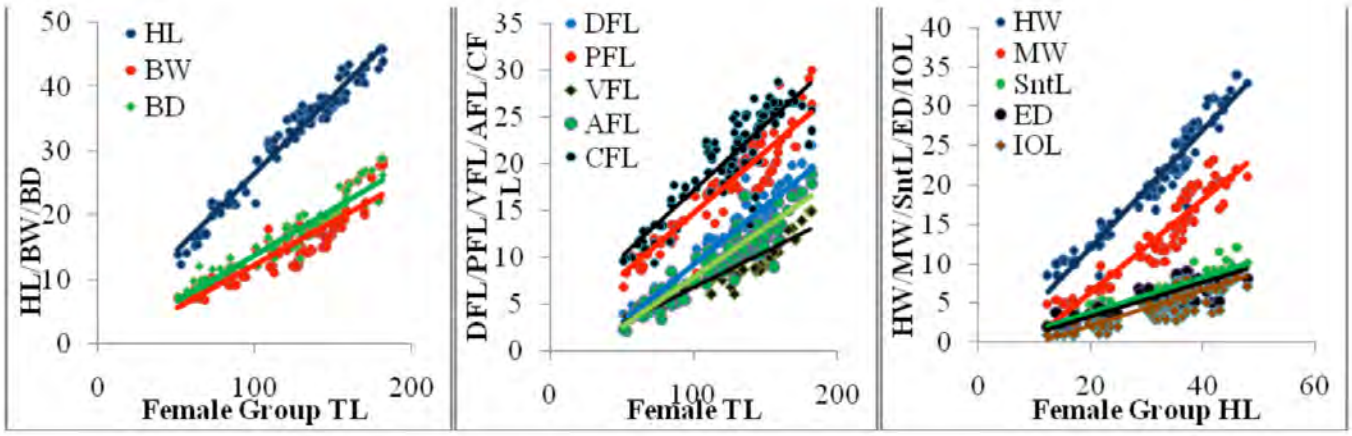

Fig. 3. Relative Growth Patterns of Female Group.

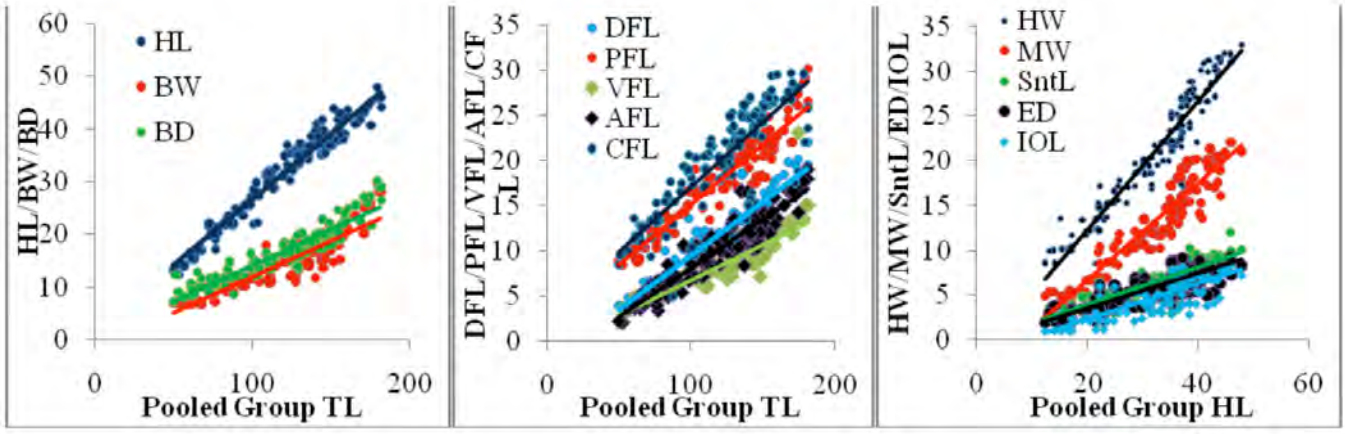

Fig. 4. Relative Growth Patterns of Pooled Group.

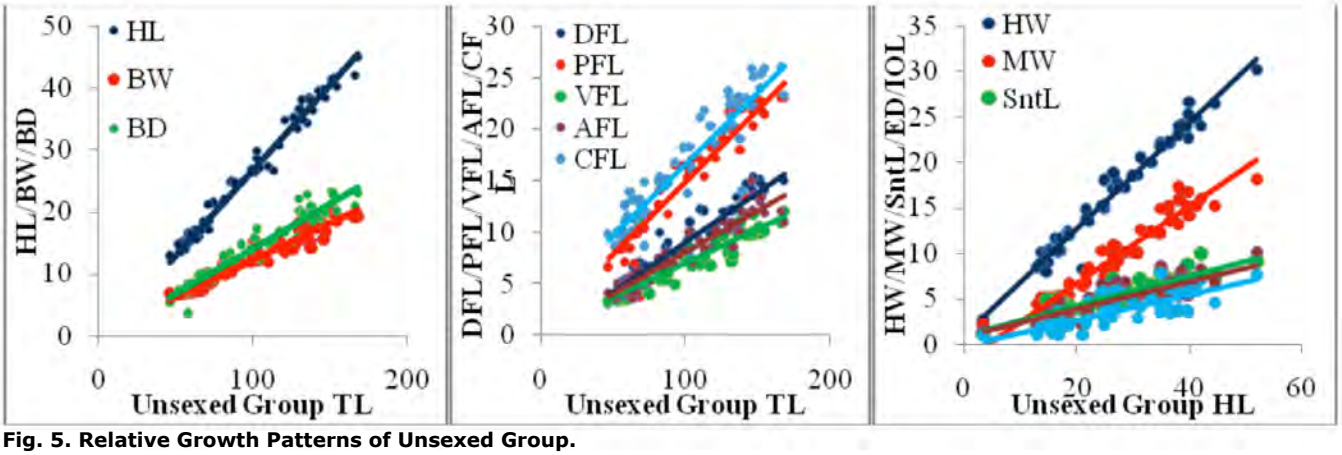

Fig. 5. Relative Growth Patterns of Unsexed Group.

HL - Head Length, BW - Body Width, BD - Body Depth, DFL - Dorsal Fin Length, VFL - Ventral Fin Length, AFL - Anal Fin Length, CFL - Caudal Fin Length, HW - Head Width, MW - Mouth Width, SntL - Snout Length, ED - Eye Diameter, IOL - Inter Orbital Length

df=5, P<0.5) and 2.803 (t=3.038, df=5, P<0.5) respectively. The scrutiny of value 'r' indicated high degree of positive correlation between the two variables in all groups (Table1). The L-W-R curves for each, i.e., male, female, pooled and unsexed groups were also plotted in scatter diagram (Fig. 1). The analysis of condition factor 'K' and relative condition factor (Kn) for different size groups (40 to 160 mm SL) of both sexes revealed that the 'K' value was above '1' which indicated well being of fish. The highest values of 'K' (2.32 and 2.37) were noted in size group of 40-60 mm in both sexes. Further, the 'Kn' was lower than 1 in some groups of male though in female it was almost equal to 1. In male 'Kn' was higher (1.14) in 40-60mm group, but in female (1.05) in 100-120 mm group (Table 2). The relative growth patterns of various body parts in relation to total length (TL) and the head length (HL) of all the groups were analyzed by using the slope 'b' value of the regression line. The values of 'r' indicated high degree of correlation of TL and HL with their respective body parameters. In male, female, pooled and unsexed groups all the body parameters exhibited 'r' greater than 0.90 except male (CFL 0.82); female (PFL 0.89 and CFL 0.89); pooled (VFL 0.89 and CFL 0.84) with TL. The male (SntL 0.84, ED 0.73 and IOL 0.63); female (ED 0.86, IOL 0.84); pooled (SntL 0.89, ED 0.83 and IOL 0.78) and unsexed group's (ED 0.85 and IOL 0.79) with HL. Moreover, the extent of variation in body parameters was measured by the values of 'R2' which ranged from 68.3-96.6%, 79.3-95.5%, 71.2-95.5% and 81.5-96.1% with TL and 40.6-90.8%, 71.8-92.3%, 61.5%-91.2% and 62.9-96.9% with HL of male, female, pooled and unsexed group respectively (Table 3). Moreover, after plotting the scatter diagram of respective body parameters against TL and HL of the fish linear plots were obtained which are given in Fig. 2, 3, 4 and 5 respectively.

It is well known that length-weight relationships give information on the condition and growth patterns of fish (Bagenal & Tesch, 1978). Fish are said to exhibit isometric growth when length increases in equal proportions with body weight for constant specific gravity. The regression co-efficient for isometric growth is '3' and values greater or lesser than '3' indicates allometric growth (Gayando & Pauly, 1997). In the present study the values of length-weight regression coefficient 'b' obtained for male, female, pooled and unsexed group were subjected to t-test to analyze weather 'b' values were different from the cube law at 95% confidence limit. As such it was observed that 'b' values were significantly different from the cube for female (2.792) and pooled group (2.803) and exhbited non-isometric growth, but in case of male (2.804) and unsexed group (2.863) isometric growth was obtained. Alfred (1996) explained the length weight relationship of *Channa* sp. and reported that males were longer than females and allometric pattern was observed for both sexes. Further, Ali *et al*. (2000) reported that growth in weight was allometric of the body form (W=-1.86 L 2.88). The body proportions changed with growth and condition factor showed no significant correlation with increasing length and weight. Ebanasar & Jayaparkas (2005) reported that a significant difference in the 'b' value of juveniles, immature and adults which was found to be 2.5837 in juveniles and immature fishes had a maximum 'b' value of 2.7347. The males and females had the lowest 'b' values i.e. (2.1837 and 2.1418 respectively) where as growth was found to be allometric. Singh and Ram (2011) observed that the value of 'a' and 'b' ranged from 1.445 to 2.348 and -0.036 to 0.168 for natural condition and -0.006 to 1.950 and -0.022 to 1.891 for captive condition. In case of female fish the value of 'a' and 'b' ranged from 0.083 to 2.161 and 0.078 to 1.713 for natural condition and -0.207 to 2.078 and -0.216 to 1.766 for captive conditions respectively.

In the present study, 'K' and 'Kn' for different sized male and female were found to be almost equal or above '1' indicated good condition of the fish. But the highest values of 'K' (2.32 and 2.37) were recorded in size group of 40-60 mm in both sexes, which was attributed to the voracious behavior. In both sexes the value of 'K' showed almost decreasing trends with increasing length, except few exception in male where it exhibited an increasing trend after attaining 140-160 mm size. The probable reason behind this may be that fish of different size groups were in different stages of gonad development as suggested by Reddy & Rao (1992). The highest 'Kn' (male = 1.14, female = 1.05) in male and female depicted that the female were attaining sexual maturity in the given size group, except 140-160 mm group (Kn = 0.96) due to less intake of food but male (40 -60mm) was highly voracious to accumulate energy for maturation. The trend in fluctuation of the 'K' and 'Kn' were almost similar although they differ in magnitude which pointed that both male and female (40-60 mm) are highly voracious in nature while the feeding intensity varies significantly depending upon their sexual stages.

The relative growth patterns of various body parts in relation to total length (TL) and head lengths of all groups were analyzed. The statistical analysis of regression revealed a linear relationship between all the body parameters and TL as well as HL. The value of 'b' (slope) was used as indicator of growth in each body part with a unit increase in TL or HL of the fish. In male fish a unit increase in the TL displayed highest growth rates with HL (0.268 mm), CFL (0.146 mm) and PFL (0.140 mm) while BW, BD, DFL, AFL exhibited growth less than 0.140 mm. In male fish least increment of 0.072 mm was noticed with VFL. Similarly, a unit increase of HL leads to a highest increment of 0.633 mm in HW and lowest 0.136 mm with IOL. In case of female, the highest growth were observed with HL (0.242 mm), BD (0.143 mm) and CFL (0.140) with a unit increase in TL while BW, DFL, PFL, VFL and AFL displayed less than 0.140 mm growth. But a unit increase in the HL of female fish led to increase the HW, MW, SntL, ED and IOL comparatively more than male fish. Each body parameter exhibited a linear relationship with TL and HL as such their reliability can be verified from the high degree of positive correlation 'r' as well as 'R^2'between them. The results of the present study were in accordance to the Dars *et al*. (2012). The morphometric characters of fish may vary with in a species or genus as Goswami *et al.* (2006) reported that *C. baraca, C. aurantimaculata, C. stewarti* and *C. bleheri* showed a marked difference in almost all the characters. But in the present study the relative growth patterns of the entire groups did not presented any marked difference from each other. Thus, after establishing the equations for length weight relationship for both the sexes separately and combine, a high degree of positive correlation between length and weight was observed. The values of 'K', 'Kn' and 'b' indicated good environmental

condition for the betterment of the fish. Further, the growth patterns of all the morphometric parameters inferred a linear relationship in respect of total length and head length.

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PRESS RELEASE
UN General Assembly proclaims 3 March as World Wildlife Day

Geneva, 23 December 2013 – On 20 December 2013, the Sixty-eighth session of the United Nations General Assembly decided to proclaim 3 March, the day of the adoption of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), as World Wildlife Day, to celebrate and raise awareness of the world's wild fauna and flora.

In its resolution, the General Assembly reaffirmed the intrinsic value of wildlife and its various contributions, including ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic, to sustainable development and human well-being, and recognized the important role of CITES in ensuring that international trade does not threaten the species' survival.

The General Assembly requested the CITES Secretariat, in collaboration with relevant organizations of the United Nations system, to facilitate the implementation of World Wildlife Day.

Welcoming the news, CITES Secretary-General, Mr John E. Scanlon, said, "World Wildlife Day is an ideal opportunity to celebrate the many beautiful and varied forms of wild fauna and flora and raise awareness of the multitude of benefits that conservation provides to people. At the same time, the Day reminds us of the urgent need to step up the fight against wildlife crime, which has wide-ranging economic, environmental and social impacts."

"We invite all member States, relevant organizations of the United Nations system as well as all other interested organizations and individuals -- from airports to museums to schools -- to get involved in this global celebration of wildlife", added Scanlon.

The CITES Secretariat has created a dedicated World Wildlife Day Facebook page to share news and stories of the Day, which can be followed at: https://www.facebook.com/WorldWildlifeDay
http://www.cites.org/eng/news/pr/2013/20131223_world-wildlife-day.php