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BIOMETRIC STUDIES IN THREE TELEOST FISHES

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(With 5 Text-figures)

INTRODUCTION

Studies on biometry, length-weight relationship and condition factor of important fishes have been carried out in different countries. But Allometric observations on Indian fishes are very meagre. Allometry deals with the size relationships between the whole and its parts. Some of the important observations on allometry are by Banarjee and Venkateswarlu (1969), Venkateswarlu (1962a, 1962b and 1968), Venkateswarlu and Banarjee (1970, 1971 and 1975) and Ramaprasad (1968).

In the present paper some observations were made on the length-weight relationship, biometry, allometry and condition factor in three species of fresh water Cypriniids, *Puntius conchonius* (Ham.), *Puntius amphibius* (V.) and *Crossocheilus latius* (Ham.)

MATERIAL AND METHODS

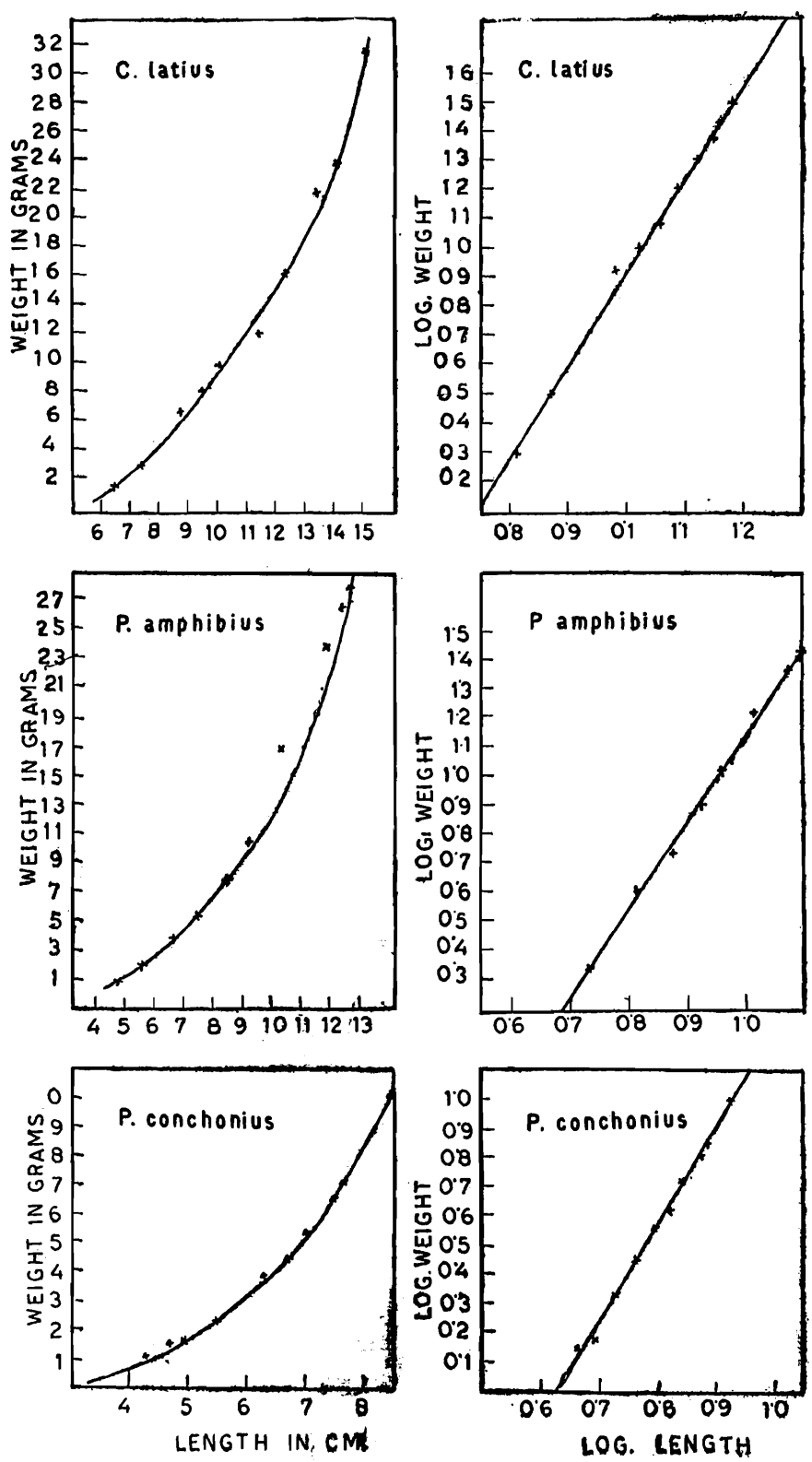
The present study is based on 293 specimens of *Puntius conchonius* (Ham.), 342 specimens of *Puntius amphibius* (V.) and 292 specimens of *Crossocheilus latius* (Ham.). The fishes were obtained locally at Patna (Bihar). As soon as the fishes are brought to the laboratory, weight was taken in fresh condition and preserved in 4% formaldehyde solution uniformly. Measurements of the different parts of the body were taken on a measuring board. Small measurements were taken with the help of a fine dividers. The length was measured to the nearest millimeter. The following measurements were taken : Total length, fork length, snout to dorsal, snout to venrtal, snout to anal, snout to pectoral, greatest body height, height of caudal peduncle, head length, pectoral length and dorsal length.

The specimens are grouped, the class interval being 1.0 cm. in *P. amphibius* (V.) and *C. latius* (Ham.) and 0.3 cm. in *P. conchonius*.

The length weight relationship was studied by applying the equation $W=CL^n$. The growth of different body parts with relation to standard length was studied by regression analysis using Least Squares method. Allometry was studied following the method of Rensch (1959).

Length Weight Relationship

The length weight relationship of most of the fishes can be expressed by a general equation $W=CL^n$, where 'W' is the weight in grams, 'L'



Text-fig. 1

is the length in centimeters, 'C' is the constant and 'n' is exponent. In practice, Le Cren (1951) indicates the length weight relationship would first be calculated as the logarithmic formula, Log W = Log C + n Log L, where 'n' represents the slope of line and 'C' its position.

In the present study where the average values are plotted, an exponential curve was obtained in all the 3 species (Text-fig. 1). This shows that the weight of the fish increases as an exponential function of its length. The logarithmic relation of length and weight was found to be a straight line (Text-fig. 1). The formulae worked out are as follows :

P. conchonius	$W = 0.001347\ L^{3.164}$
P. amphibius	$W = 0.002461\ L^{3.073}$
C. latius	$W = 0.01746\ L^{3.243}$

According to Hile (1936) and Martin (1949), the value of the exponent 'n' usually lies between 2.5 and 4.0 and for an individual fish which maintains same shape it will be 3.0 (Allen, 1938). In the present study the values of 'n' are 3. 164, 3.073 and 3.243 which are ideal and the three species maintain the same shape throughout their life. Hence it can be inferred that the weight increases in proportion to its length showing the normal pattern.

BIOMETRY

The mean values of various parameters in three species were given in Tables 1,2 and 3. The mean values of log. weight and log. total length were given in Table 4. The values of sums of different parameters were given in Table 5. The values of regression equation $Y = a + bx$, the angle of slope of regression line, the tangent of the angle and allometry were given in Tables 6,7 and 8. The regressions were shown in Text-figs. 2,3 and 4.

It is seen from the above Text-figures, that the fastest growing parameter is the total length in all the three species and slowest growing parameter is height of caudal peduncle. Next to total length, fork length is the fast growing parameter in all the three species and next to height of caudal peduncle, the slow growing parameters are dorsal length in *P. conchonius* and pectoral length in *P. amphibius* and *C. latius*. The rate of growth of other parameters are varied and can be seen from Text-figs. 2, 3 and 4.

TABLE 1. Showing mean values of *Puntius conchonius* (Ham.) in cm.

Sl. No.	Class interval	Weight	Total length	Standard length	Fork length	Snout to dorsal	Snout to anal	Snout to ventral	Snout to pectoral	Body height	Height of C. P.	Head length	Pecto-ral length	Dorsal length
1.	4.0 to 4.3	1.0	4.2	3.2	3.7	1.8	2.3	1.7	1.0	1.4	0.6	1.0	0.8	0.7
2.	4.4 to 4.7	1.4	4.6	3.5	4.0	2.0	2.6	1.9	1.0	1.5	0.6	1.0	0.9	0.8
3.	4.8 to 5.1	1.5	4.9	3.8	4.3	2.1	2.8	2.0	1.1	1.6	0.7	1.0	0.9	0.9
4.	5.2 to 5.5	2.2	5.4	4.2	4.8	2.2	3.1	2.2	1.2	1.8	0.7	1.2	1.0	1.0
5.	5.6 to 5.9	2.9	5.7	4.5	5.1	2.4	3.3	2.3	1.2	1.9	0.7	1.2	1.0	1.0
6.	6.0 to 6.3	3.7	6.2	4.8	5.4	2.6	3.6	2.5	1.3	2.1	0.8	1.3	1.1	1.1
7.	6.4 to 6.7	4.3	6.6	5.1	5.8	2.8	3.8	2.8	1.4	2.3	0.8	1.4	1.2	1.1
8.	6.8 to 7.1	5.2	6.9	5.3	6.1	3.0	4.0	2.8	1.4	2.5	0.9	1.4	1.2	1.1
9.	7.2 to 7.5	6.4	7.4	5.8	6.5	3.2	4.3	3.1	1.5	2.6	1.0	1.5	1.2	1.2
10.	7.6 to 7.9	7.0	7.6	5.9	6.6	3.4	4.4	3.1	1.6	2.8	1.1	1.6	1.3	1.3
11.	8.0 to 8.4	10.0	8.4	6.9	7.6	3.9	5.0	3.5	1.7	3.3	1.1	1.7	1.5	1.4

TABLE 2. Showing mean values of *Puntius amphibius* (V.) in cm.

Sl. No.	Class interval	Weight	Total length	Standard length	Fork length	Snout to dorsal	Snout to anal	Snout to ventral	Snout to pectoral	Body height	Height of C. P	Heah length	Pecto-ral length	Dorsal length
1.	4.0 to 5.0	1.0	4.7	3.6	4.0	1.8	2.5	1.8	1.0	1.3	0.5	1.1	0.9	0.8
2.	5.0 to 6.0	2.2	5.4	4.3	4.8	2.3	3.2	2.2	1.3	1.6	0.7	1.3	1.0	0.9
3.	6.0 to 7.0	4.1	6.5	5.2	5.8	2.7	3.8	2.6	1.4	1.9	0.8	1.5	1.2	1.0
4.	7.0 to 8.0	5.5	7.4	5.9	6.5	3.0	4.3	2.9	1.6	2.1	0.9	1.6	1.3	1.1
5.	8.0 to 9.0	8.0	8.4	6.7	7.4	3.4	4.9	3.3	1.8	2.4	1.0	1.8	1.4	1.3
6.	9.0 to 10.0	10.4	9.1	7.4	8.1	3.7	5.4	3.6	1.9	2.8	1.1	1.9	1.5	1.4
7.	10.0 to 11.0	17.0	10.3	8.3	9.1	4.3	6.1	4.3	2.2	3.1	1.2	2.3	1.6	1.6
8.	11.0 to 12.0	24.0	11.8	9.5	10.3	4.8	7.0	4.6	2.4	3.8	1.4	2.5	1.8	2.0
9.	12.0 to 13.0	26.7	12.3	10.0	10.7	5.1	7.6	5.0	2.5	3.9	1.5	2.5	1.8	2.2
10.	13.0 to 14.0	28.0	12.5	10.2	10.8	5.2	7.8	5.1	2.6	4.0	1.6	2.7	1.9	2.3

TABLE 3. Showing mean values of *Crossocheilus latius* (Ham.) in cm.

Sl. No.	Class interval	Weight	Total length	Standard length	Fork length	Snout to dorsal	Snout to anal	Snout to ventral	Snout to pectoral	Body height	Height of C. P.	Head length	Pecto-ral length	Dorsal length
1.	6.0 to 7.0	2.0	6.4	5.0	5.7	2.2	3.7	2.5	1.2	1.0	0.6	1.1	1.1	1.0
2.	7.0 to 8.0	3.2	7.4	6.0	6.5	2.6	4.5	2.9	1.6	1.3	0.6	1.3	1.3	1.1
3.	8.0 to 9.0	7.0	8.7	7.2	7.7	3.5	5.5	3.7	2.0	1.9	0.9	1.9	1.4	1.7
4.	9.0 to 10.0	8.6	9.5	7.6	8.3	3.6	6.0	4.0	2.1	2.0	1.0	2.0	1.4	1.7
5.	10.0 to 11.0	10.2	10.5	8.3	9.0	4.0	6.5	4.4	2.2	2.2	1.0	2.2	1.6	1.8
6.	11.0 to 12.0	12.4	11.4	9.1	9.9	4.3	7.2	4.8	2.3	2.3	1.1	2.3	1.7	1.9
7.	12.0 to 13.0	16.6	12.3	9.9	10.6	4.6	7.8	5.2	2.5	2.7	1.2	2.5	1.8	2.1
8.	13.0 to 14.0	21.0	13.3	10.6	11.4	5.0	8.2	5.5	2.7	2.9	1.3	2.6	2.0	2.2
9.	14.0 to 15.0	24.0	14.0	11.3	12.3	5.3	9.0	6.0	2.7	3.1	1.3	2.7	2.1	2.3
10.	15.0 to 16.0	32.0	15.0	12.4	13.4	5.7	9.7	6.5	3.1	3.4	1.4	2.7	2.2	2.6

TABLE 4. Showing mean values of Log. length and Log. weight in three species.

Puntius conchonius (Ham.)		*Puntius amphibius* (V.)		*Crossocheilus latius* (Ham.)	
Log. Total Length	Log. Weight	Log. Total length	Log. Weight	Log. Total length	Log. Weight
0.6232	0.0000	0.6721	0.0000	0.8062	0.3010
0.6628	0.1461	0.7324	0.3424	0.8692	0.5051
0.6902	0.1761	0.8129	0.6128	0.9395	0.8451
0.7324	0.3424	0.8692	0.7404	0.9777	0.9345
0.7559	0.4624	0.9243	0.9031	1.0212	1.0086
0.7924	0.5682	0.9590	1.0170	1.0469	1.0934
0.8195	0.6335	1.0128	1.2304	1.0899	1.2201
0.8388	0.7160	1.07119	1.3802	1.1239	1.3222
0.8692	0.8062	1.0899	1.4265	1.1461	1.3802
0.8808	0.8451	1.0969	1.4472	1.1761	1.5051
0.9243	1.0000				

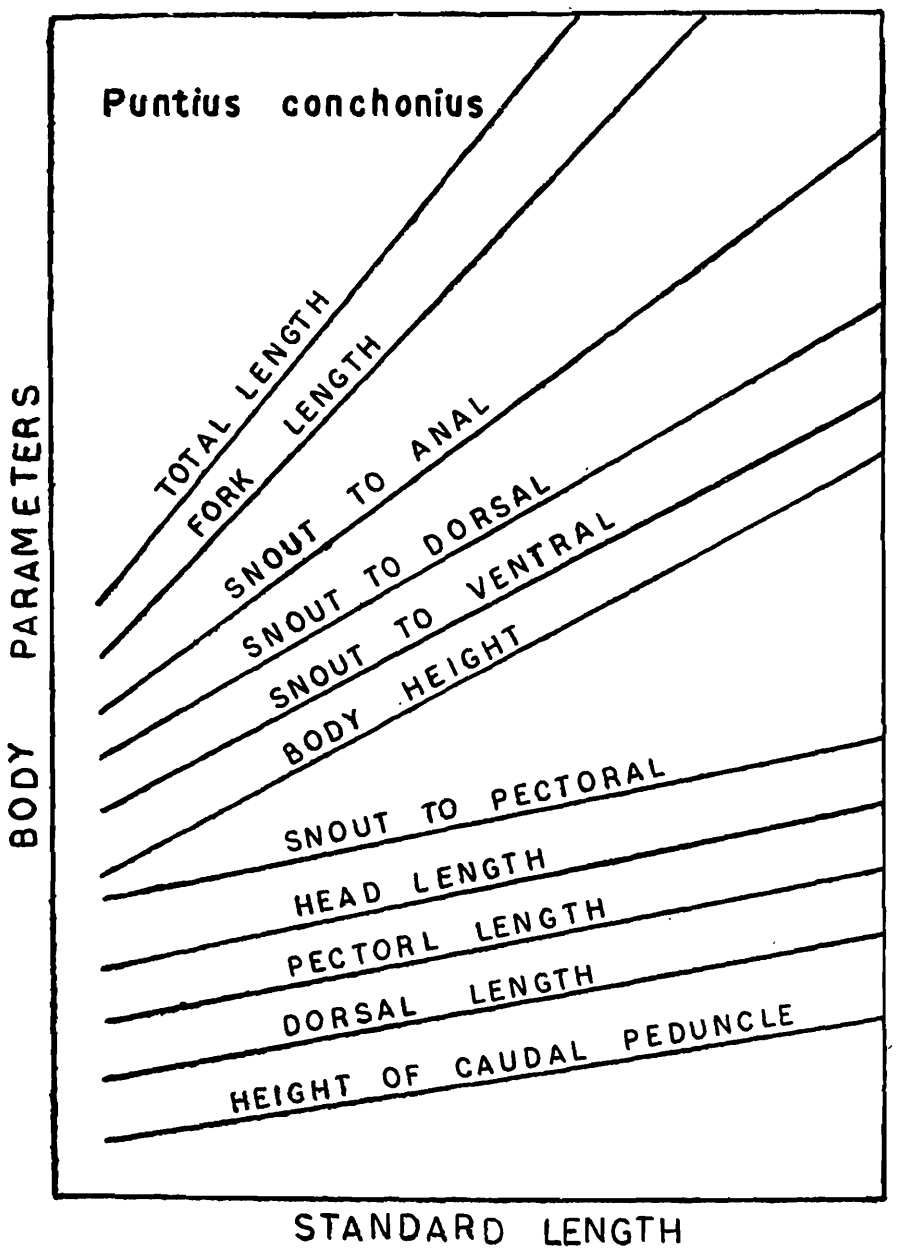
TABLE 5. Showing the values of sums in three species.

Parameter		*Puntius-conchonius*	*Puntius-amphibius*	*Crossocheilus-latius*
Standard-length	X	53.0	71.1	87.4
	X^2	272.02	556.13	814.12
Weight	Y	45.6	126.9	137.0
	XY	250.76	1119.09	1397.40
Total-length	Y	67.9	88.4	108.5
	XY	342.20	689.31	1009.58
Fork-length	Y	59.9	77.5	94.8
	XY	302.20	603.61	884.74
Snout to-dorsal	Y	29.4	36.3	40.8
	XY	148.97	283.60	380.60
Snout to-anal	Y	39.2	52.6	68.3
	XY	198.23	412.37	636.29
Snout to-ventral	Y	27.9	35.4	45.5
	XY	140.82	276.73	425.32
Snout to-pectoral	Y	14.4	18.7	22.4
	XY	71.99	144.61	207.47
Body-height	Y	23.8	26.9	22.8
	XY	121.35	212.26	215.53
Height of-C. P.	Y	9.0	10.7	10.4
	XY	45.34	83.70	96.70
Head-length	Y	14.3	19.2	21.3
	XY	71.61	148.29	197.67
Pectoral-length	Y	12.1	14.4	16.6
	XY	60.57	109.69	152.80
Dorsal-length	Y	11.6	14.6	18.4
	XY	58.17	115.05	171.33

Allometry

Rensch (1959) states that the process of allometric growth may be mathematically derived by a function formula $y=bx$ in which 'y' is the size of the organ under consideration and 'x' the body size. 'b' is the growth coefficient from which the size of the organ to a given body size can be calculated. It will be realized that the above formula may be written as Log $y=\log b+\log x$, from which it is evident that in system of logarithmic coordination this straight line indicates the degree of positive or negative allometry ($>45°$=positive, $<45°$=negative, $45°$= isometry.)

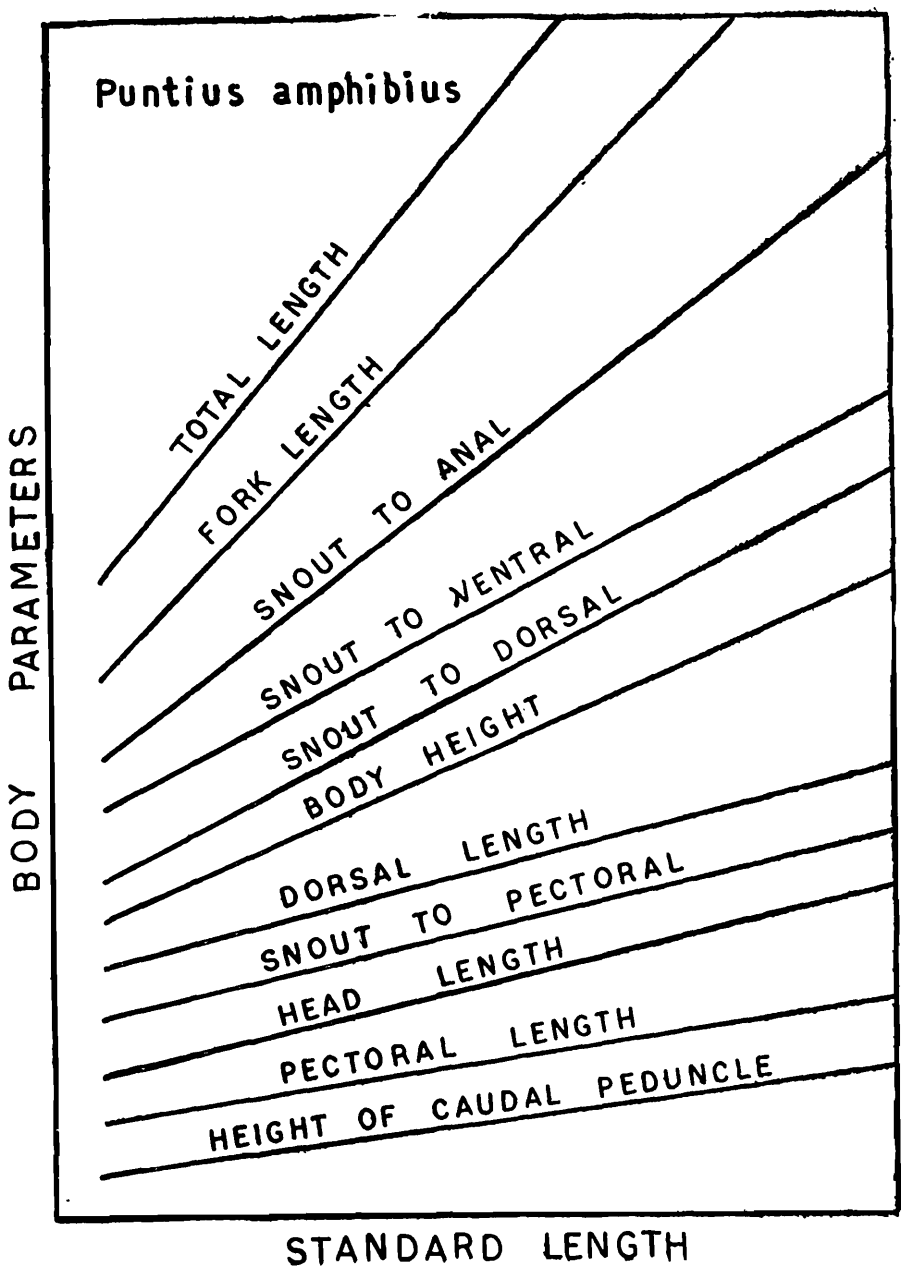
The measure of the slope of regression lines for different parameters and corresponding allometry in the three species are given in Tables 6, 7 and 8.



Text-fig. 2

TABLE 6. Showing Regression equations and Allometry in *Puntius conchonius* (Ham.)

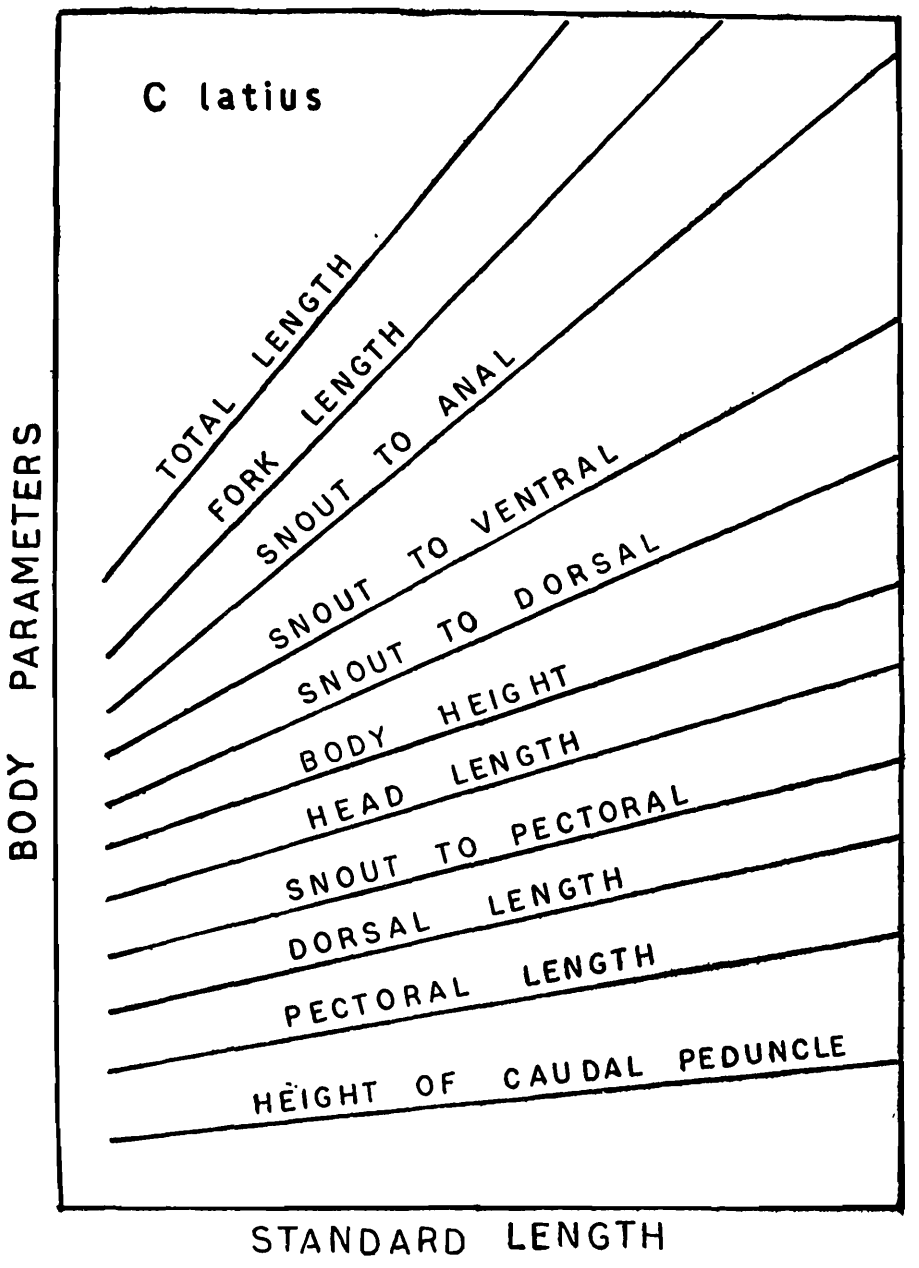
Parameter	Regression equation Y = a + b x	Angle	Tangent of the angle	Allometry + or −
Total length	0.023 + 1.248 x	51°	1.2349	+
Fork length	0.002 + 1.105 x	47°	1.0724	+
Snout to anal	9.011 + 0.746 x	38°	0.7813	—
Snout to dorsal	−0.066 + 0.584 x	30°	0.5774	—
Snout to ventral	0.061 + 0.527 x	29°	0.5543	—
Body height	0.046 + 0.539 x	29°	0.5543	—
Snout to pectoral	0.106 + 0.232 x	12°	0.2126	—
Head length	−0.034 + 0.224 x	12°	0.2126	—
Pectoral length	0.011 + 0.221 x	12°	0.2126	—
Dorsal length	−0.033 + 0.194 x	10°	0.1763	—
Height of caudal peduncle	0.004 + 0.166 x	9°	0.1584	—



Text-fig. 3

TABLE 7. Showing Regression equations and Allometry in *Puntius amphibius* (V.)

Parameter	Regression equation Y=a+b x	Angle	Tangent of angle	Allometry +or−
Total length	0.056+1.239 x	50° 30′	1.2131	+
Fork length	0.004+1.084 x	46°	1.0355	+
Snout to anal	−0.002+0.749 x	37°	0.7536	—
Snout to ventral	−0.001+0.498 x	27°	0.5095	—
Snout to dorsal	−0.003+0.509 x	27°	0.5095	—
Body height	0.041+0.410 x	23° 30′	0.4348	—
Dorsal length	0.164+0.213 x	14°	0.2493	—
Snout to pectoral	0.026+0.254 x	13°	0.2309	—
Head length	0.043+0.246 x	13°	0.2309	—
Pectoral length	−0.063+0.164 x	8°	0.1405	—
Height of caudal-peduncle	0.004+0.151 x	7°	0.1228	—



Text-fig. 4

TABLE 8. Showing Regression equations and Allometry in *Crossocheilus latius* (Ham.)

Parameter	Regression equation Y = a + bx	Angle	Tangent of angle	Allometry
Total length	0.005 + 1.241 x	50° 30'	1.2131	+
Fork length	−0.002 + 1.084 x	46° 30'	1.0538	+
Snout to anal	−0.012 + 0.810 x	40°	0.8391	—
Snout to ventral	−0.009 + 0.524 x	29°	0.5543	—
Snout to dorsal	0.084 + 0.801 x	24°	0.4245	—
Body height	0.071 + 0.312 x	19°	0.3443	—
Head length	0.043 + 0.301 x	17°	0.3057	—
Snout to pectoral	0.004 + 0.243 x	13°	0.2309	—
Dorsal length	0.002 + 0.210 x	12°	0.2126	—
Pectoral length	−0.013 + 0.161 x	9°	0.1584	—
Height of caudal-peduncle	0.001 + 0.118 x	5°	0.0875	—

From the tables it is evident that total length and fork length alone have positive allometry and all the rest negative allometry in all the three species. It is further proved by the fact that in the regression equations the value of 'b' (regression coefficient) for the total length and fork length are above 1.0 which shows positive allometry and for the rest it is below 1.0 showing negative allometry. So it can be concluded that total length and fork length are fast growing parameters and the rest are slow growing parameters.

Condition Factor

Le Cren (1951) observed that the condition factor forms an important part about feeding, spawning and other aspects related to the well being of the fish. Hart (1946) observed that, since the adolescent fishes have higher 'K' values than the older fishes, the increase and decrease in the 'K' values related to the increasing length can be employed to determine the size at first maturity. The formula applied is

$$K = \frac{W}{L^3 \times 100}$$

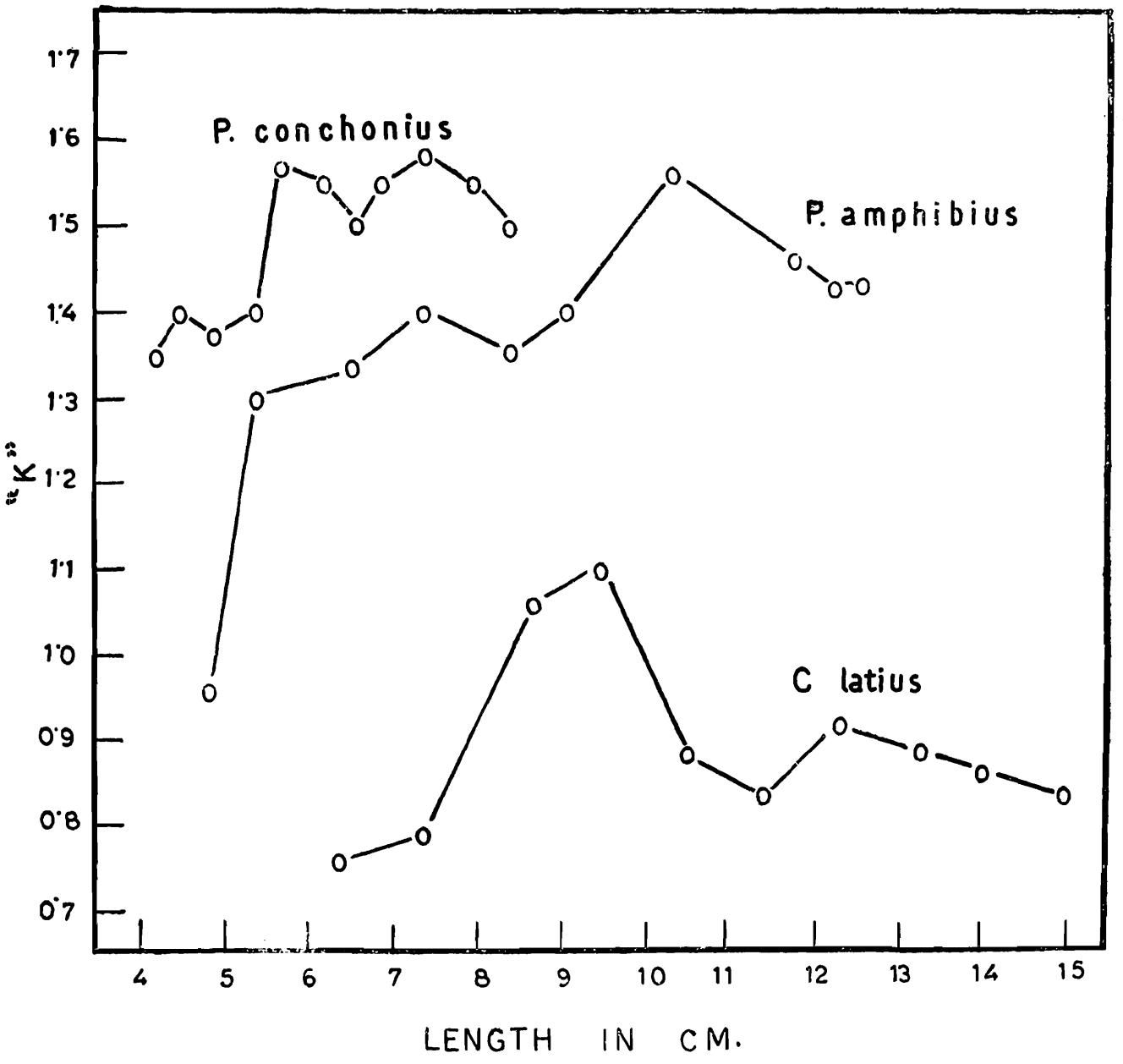
The average values of length and 'K' are given in Table No. 9.

It is observed from Text-fig. 5 that the first point of inflection in the curve is at 5.7 cm. for *P. conchonius*, 7.4 cm. for *P. amphibius* and 9.5 cm. for *C. latius*, which shows that the fish matures at that average length. But there is one more inflection in the curve at 7.4 cm. for *P. conchonius*, 10.3 cm. for *P. amphibius* and 12.3 cm. for *C. latius*. These secondary falls in the three species starting from 7.4 cm., 10.3 cm. and 12.3 cm. are probably because of increasing metabolic strain

TABLE 9. Showing total length and values of "K" in three species.

Puntius conchonius (Ham.)		*Puntius amphibius* (V.)		*Crossocheilus latius* (Ham.)	
Length	"K"	Length	"K"	Length	"K"
4.2	1.35	4.7	0.96	6.4	0.76
4.6	1.40	5.4	1.30	7.4	0.79
4.9	1.37	6.5	1.33	8.7	1.06
5.4	1.40	7.4	1.40	9.5	1.10
5.7	1.57	8.4	1.35	10.5	0.88
6.2	1.55	9.1	1.40	11.4	0.83
6.6	1.50	10.3	1.56	12.3	0.92
6.9	1.55	11.8	1.46	13.3	0.89
7.4	1.58	12.3	1.43	14.0	0.87
7.6	1.55	12.5	1.43	15.0	0.84
8.4	1.69				

due to spawning in older age groups as has been indicated in many other species (Hart, 1946 ; Menon, 1950 ; Qayyum and Qasim, 1964 and 1965.)



Text-fig. 5

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