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MORPHOMETRIC STUDIES ON THE EXTERNAL ORGANS AND PARTS OF THE FRESHWATER FARMED ROHU, *LABEO ROHITA* (L .)

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Abstract

Forty five farmed rohu, *Labeo rohita* collected were used in the present study. The total length of the fish ranged from 15.6 to 31.5cm and wet body mass from 36.82 to 350.17g. Morphometry of 18 different organs/parts was examined as following: body mass Vs total length, body mass Vs organ mass, total length Vs organ length. The log transformed regression parameters were used to test allometric growth of these variables. It was observed that fork and standard length showed negative allometry against total length, maximum mouth gape and head mass showed negative allometry against both total length and body mass. It was also observed that body mass, dorsal pectoral, caudal, pelvic, anal, total fins length, caudal pectoral, pelvic, and dorsal, total fins and scales mass showed positive allometry with total length. On the other hand, scales, pectoral, anal, pelvic and total fins mass showed positive allometry against body mass. Isometric growth was shown by caudal and dorsal fin mass against body mass. Negative allometry was shown by head mass against head length and positive allometry by standard length against fork length.

Key words: farmed fish, organ morphometry, regression models, *Labeo rohita*, allometry, body mass

Introduction

Fish observe several growth stages or stanzas during their course of development, each of which has its own mass-length parameters (Vasnetsov, 1953). These parameters tend to remain constant during each stage of growth both in different environments as well as throughout the year (Bagenal & Tesch, 1978). Often changes in mass-length parameters occur either between stanzas at metamorphosis, at first maturity or following major environmental changes (Deegan, 1985). Hence mass-length parameters become important for comparing different stanzas of growth, production and other formulation.

The growth in animals is considered in terms of increase in volume. The volume is represented by mass, which is related to the cube of the linear dimension. It is therefore, true that a relationship exists between length and mass in animals (Kellicot, 1908). Mass-length relationship has been calculated by the allometric growth formula applied by Weatherly and Gill (1987); Salam and Janjua (1991) and Salma and Khaliq (1992), in the form of:

$$W = aL^b$$

Where

W (g) is the body mass

L (cm) is the total body length

a and b are constant

In fish 'b' is the slope of the log-log regression that usually has a value between 2 and 4 (Martin, 1949). If b is more than 3, the fish is heavier for its length than an ideal symmetrical fish. When b is less than 3 the fish is lighter for its length than an ideal symmetrical fish (Bagemal and Tesch. 1978).

The mass of a fish is influenced by season, spawning condition, sexual maturity and even time of the day (LeCren, 1951). The mass of

a fish is also affected by the presence of food in the gut.

Mass-length relationship is a mathematical formulation, which enables one variable to be predicted from the other (Brown, 1957). Morphometric studies on various species of fish have been carried out to correlate growth patterns (Amanullah et al., 2000; Naeem et al. 2000 and De Silva et al., 2002). The main objective of the present work was to study the morphometry of the external body organs/parts of the fresh water farmed rohu, *Labeo rohita*.

Materials and Methods

45 farmed rohu, *Labeo rohita* were obtained from Government Fish Seed Hatchery, Mian Channu during the month of November. The total length of these fishes ranged from 15.6 cm to 31.5 cm and body mass fluctuated from 36.82g to 350.17g. These fishes were transported live to the laboratory in plastic containers, killed, by using heavy dose of anesthetic (MS 222) then blotted dry on a paper towel and weighed to 0.01g on an electronic balance (Chyo, MP-3000). Body length measurements were taken by using a measuring tape. Total length was taken as the length from tip of the snout to the tip of the tail. Fork length was taken as the length from the tip of the snout to the tip of the shortest median fin ray of the tail, while standard length was taken as the length from terminal mouth to the hidden base of the caudal fin. Head length was taken as the distance from the most anterior part on snout to the posterior edge of opercula bones.

Mouth dimension was measured using vernier calipers. Maximum mouth gape was taken as the vertical distance between the tips of upper and lower jaw when the gape was maximal. Scales of fish were removed with the help of a pair of forceps and then weighed. All fins i.e. pectoral, pelvic, caudal, dorsal and anal were separated form the fish with the help of scissors and were washed in distilled water. Finally these fins were blotted dry and weighed to a fraction of 0.01g.The length of each fin was also measured. Head was also removed and weighed.

Condition factor was calculated by using the following formula:

Condition factor $K = W/L^3 \times 100$ (Hile, 1936)

The index of body organs was calculated by the following formula:

$$\text{Index of body organs} = \frac{\text{Mass of organs (g)}}{\text{Total body mass(g)}} \times 100$$

The statistical analysis and graphics were performed by using computer package of Microsoft excel and minitab, following Zar (1996).

Results

Mean values (±S.D) and ranges of various body organs/parts of *Labeo rohita* are given in Table 1. Data regarding the variations in body organs/parts and their correlations in relation to size are analyzed and described in the sections below.

Organs Morphometry:

Total mass of all organs/parts when plotted against wet body mass or total length have the general form:

$$Y = zX^b \text{ or } W = aM^b \text{ or } L = aM^b \quad (1)$$

Where W is mass of an organ, M is wet body mass, L is total length, a is constant and b is exponent. The values of exponent (b) for log wet body mass versus log organs/parts mass or log total length versus log organs/parts mass should be b = 1.00 for former and b = 3.00 in later case, respectively for ideal symmetrical growth.

Relative growth of an organ or part was classified as negative allometry (b < 1 or b<3) positive allometry (b>1 or b>3) where b differed significant (P < 0.05). Allometry with b-value not differing significantly was classified as isometry (b = 1or b = 3).

1. The relationship between log wet body mass and log body organs/parts mass:

A highly significant positive correlation was found between log transformed data of all the parameters and log wet body mass. On calculation of regression coefficient (b) for all the parameters against log wet body mass it was found that caudal and dorsal fin increased in direct proportion (isometric, b=1), head increased at a decelerating rate (negative allometry, b < 1), whereas the rest increased at an accelerating rate (Positive allometry, b >1) (Table 2).

2. The relationship between log total length and log body organs/parts length:

A highly significant positive correlation was found between log-transformed data of all the parameters and log total length. On calculation of regression coefficient (b) for all the parameters against total length it was found that fork and standard length increased at decelerating rate (negative allometry, b<1) and rest of the parameters increased at an accelerating rate, (positive allometry, b>1) (Table 3).

3. The relationship between log total length and log body organs/parts mass:

A highly significant positive correlation was found between log-transformed data of all the parameters versus log total length. On calculation of regression coefficient (b) for all the parameters against total length it was found that head increased at decelerating rate (negative allometry, b < 3) and rest of the parameters increased at an accelerating rate, defying the cube law (Positive allometry, b >3) (Table 4).

Table 1: Indices of various body organs/parts in *Labeo rohita*

Organs/Parts	Index (Mean ± S.D.)	Range
Scales mass	2.4 ± 0.44	1.4 -3.2
Head mass	15.9 ± 3.8	8.36 – 27.8
Pectoral fin mass	0.32 ± 0.16	0.16 – 0.76
Pelvic fin mass	0.27 ± 0.06	0.18 – 0.43
Dorsal fin mass	0.22 ± 0.04	0.09 – 0.31
Caudal fin mass	0.75 ± 0.17	0.35 – 1.00
Anal fin mass	0.12 ± 0.04	0.07 – 0.20
Total fins mass	1.69 ± 0.15	1.17 –2.64

Table 2: Log wet body mass versus log organs/parts mass in *Labeo rohita*. Statistical parameters of various relationships involving log wet body mass, correlation coefficient (r), intercept (a), regression coefficient (b), standard error of b (S.E) and probabilities (P).

Regression Equation	N	r	a	b	S.E.(b)	t-value when b=1
Log wet body mass (x), g Log scales mass (y), g	45	0.98***	-1.747	1.0595	0.0048	12.395***
Log wet body mass (x), g Log head mass (y), g	45	0.95***	-0.613	0.9039	0.0054	-17.796***
Log wet body mass (x), g Log pectoral fin mass (y), g	45	0.93***	-3.055	1.2588	0.0106	24.415***
Log wet body mass (x),g Log pelvic fin mass (y),g	45	0.98***	-2.925	1.174	0.0051	34.117***
Log wet body mass (x), g Log dorsal fin mass (y),g	45	0.97***	-2.810	1.0715	0.0663	1.078^{ns}
Log wet body mass (x),g Log caudal fin mass (y),g	45	0.97***	-2.108	0.9891	0.0061	-1.786^{ns}
Log wet body mass (x), g Log anal fin mass (y),g	45	0.97***	-3.154	1.1073	0.0057	18.8224***
Log wet body mass (x),g Log total fin mass (y),g	45	0.98***	-1.982	1.1002	0.0050	20.04***

*** P < 0 .001, ** P < 0.01, *P < 0.05, otherwise P > 0.05

Table 3: Log total length versus log organs/parts length in *Labeo rohita*. Statistical parameters of various relationships involving log total length, correlation coefficient (r), intercept (a), regression coefficient (b), standard error of b (S.E) and probabilities (P).

Regression Equation	N	r	a	b	S.E.(b)	t-value when b=1
Log total length (x), cm Log fork length (y), g	45	0.99***	0.0282	0.9355	0.0029	-22.241***
Log total length (x), cm Log standard length (y), cm	45	0.996***	-0.0704	0.8916	0.0019	-9.684***
Log total length (x), cm Log pectoral fin length(y), cm	45	0.95***	-1.2166	1.3153	0.0095	33.189***
Log total length (x), cm Log pelvic fin length(y), cm	45	0.96***	-1.2237	1.2859	0.0089	32.123***
Log total length (x), cm Log dorsal fin length(y), cm	45	0.96***	-1.1675	1.3209	0.0083	38.662***
Log total length (x), cm Log caudal fin length(y), cm	45	0.95***	-0.8296	1.1407	0.0084	16.75***
Log total length (x), cm Log anal fin length(y), cm	45	0.96***	-1.2695	1.3311	0.0092	35.989***
Log total length (x), cm Log total fin length(y), cm	45	0.97***	-0.4236	1.2697	0.0069	39.086***

***P<0.001, ** P < 0 .01, * P < 0.05, otherwise P > 0.05

Table 4: Log total length versus log organs/parts mass in *Labeo rohita.* Statistical parameters of various relationships involving log total length, correlation coefficient (r), intercept (a), regression coefficient (b), standard error of b (S.E) and probabilities (P).

Regression Equation	N	r	a	b	S.E.(b)	t-value when b=1
Log total length (x), cm	45	0.98***	-4.1459	3.4018	0.0172	23.360***
Log fork length (y), g						
Log total length (x), cm	45	0.95***	-2.5181	2.792	0.0200	-10.4***
Log standard length (y), cm						
Log total length (x), cm	45	0.92***	-5.8299	3.9856	0.0379	19.073***
Log pectoral fin length(y), cm						
Log total length (x), cm	45	0.97***	-5.5209	3.7229	0.0215	33.623***
Log pelvic fin length(y), cm						
Log total length (x), cm	45	0.96***	-5.1783	3.3971	0.0238	16.684***
Log dorsal fin length(y), cm						
Log total length (x), cm	45	0.95***	-4.2775	3.1232	0.0227	5.427***
Log caudal fin length(y), cm						
Log total length (x), cm	45	0.96***	-5.6121	3.5186	0.0224	23.151***
Log anal fin length(y), cm						
Log total length (x), cm	45	0.97***	-4.4078	3.4838	0.0207	23.371***
Log total fin length(y), cm						

***P<0.001, ** P < 0 .01, * P < 0.05, otherwise P > 0.05

Discussion

In the present study caudal and dorsal fin mass showed isometric, head mass showed negative allometric and scales, pectoral, anal, pelvic, and total fins mass showed positive allometic growth against wet body mass in *Labeo rohita.*.

On comparing these results with the results obtained earlier (Amanullah, 2000) in *Ctenopharyngodon idella* and *Hypophthalamicthys molitrix* and on *Cyprinus carpio* Iqbal, (1995) it is concluded that a common trend of caudal, dorsal, anal, pectoral, total fins and head mass is apparent.

Standard and fork length showed negative allometry while pectoral, pelvic, dorsal, caudal, anal and total fins length showed positive allometric growth against total length in *Labeo rohita.* Iqbal (1995) observed similar results for pelvic fin in *Cyprinus carpio* only.

In *Labeo rohita* scales, pectoral, dorsal, and caudal, pelvic and total fins mass showed

positive allometric growth against total length. This study is in general agreement with the conclusions drawn for silver carp and grass carp for the same parameters (Amanaullah *et al.* 2000). This may be due to the fact that they belong to the group of carps showing similar pattern of growth.

It is concluded that all the organs except head are increasing with the increase of the body size and total length. This is due to the fact that the fish is growing faster and so its organs/parts are also growing faster.

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