J. Freshwater Biol. 5 (4) : 315-320 (1993)

Growth Analysis of a Freshwater Bivalve *Parreysia favidens* of Kosi River Basin

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Received : 15. 9. 93 ; Accepted : 15. 12. 93

Parreysia favidens is a common bivalve of commercial importance. The shells of the bivalve are used in the mother of pearl button industry in North Bihar. These animals are found in different dhars and rivulets of Kosi river system. The population of bivalve comprises specimens of different weight groups in the range of 0. 21 g to 9.7 g. The length, weight and breadth relationship of these specimens were analysed using Regression Analysis. The growth model of *Parreysia favidens* is governed by following eqnations :—

i) $W = 0\ 149541 \ : \ L^{3.110471}$

ii) $B = 0.719589 \ : \ L^{0.946596}$

iii) $W = 0.562109 \ : \ B^{2.901816}$

Where Length—L, Weight—W, Breadth—B.

Key words : Growth, Bivalve, *Parreysia favidens*, Kosi.

Introduction

Parreysia favidens (Bensen) belongs to family—Unionidae of order Schizondonta and Class—Bivalvia. These freshwater mussels are found in dhars and channels of river Kosi in North Bihar. It lives on the bottom burried in sand (Singh, Thakur & Datta Munshi, 1991). The shells of the bivalve, *P. favidens* are used for the preparation of Mother of pearl buttons (Datta Munshi and Choudhary, 1987). Bivalves are sluggish animals, mostly living in slow moving streams of water. Each valve of the shell is in contact with each other on its dorso—lateral region of the body. *Parreysia favidens* has a pair of gills or Ctenidium. Each ctenidium consist of two plate like flaps, the demibranchs hanging in the mantle cavity on either side of the foot. The cilia of the gills draw powerful water current into the mantle cavity which carry food materials.

The structure of the gill and brood pouch development have been studied by Scanning Electron Microscope by Pandey and Munshi (1991). The eggs are fertilized in the suprabranchial chamber during the breeding season, and then the fertilized eggs enter into the water tubes of gill through ostia along with respiratory current of water and the larvae develop in the brood pouch of gill lamina, where they reach *Glochidium* larval stage.

In this work an attempt has been made to study its length-weight relationship and growth rate.

Materials and Methods

Live specimens of *P. favidens* were collected by Ekman dredge from the river Burhi Gandak at Siuri Ghat, from 2 to 3 feet deep water. Siuri Ghat is on the bank of river Burhi Gandak, 12 kms north from Begusari railway station and 3 Kms. south from the sub-divisional head quarter, Manjhaul of Begusarai district. The specimens were opened and then fixed in 5% formalin. Shells were separated and cleaned. The bands of the shells were studied under transmitted light. A large number of both fresh and dry specimens were weighed and their length and breadth were measured. For measurement of breadth a line was drawn from the Umbo point to length line at an angle of 45° as shown in figure 3. All data related to length breadth and weight of he animals were tabulated and regression analysis was performed to get appropriate model of functional relationship between independent and dependent variables along with their coefficient of correlations and regressions.

The size-relation of body parts of an organism is related with body weight with certain mathematical principle. Huxley (1932) developed and elaborated this concept, based on the ideas of earlier workers. Huxley sought to show that many of the problems of relative growth were essentially based on simple heterogenic development. It has been found that, within any stanza of a organism's life, the weight varies as some power of length as given in the following equation :

$$W = a.\ L^{b} \qquad (1)$$

Where, a = Intercept, b = Regression Coefficient.

Results and Discussion

On the dorsal region of the shell, rings and lines appear in semi circles keeping umbo as the central point (Fig. 2). There are so many light and dark bands. The dark bands show the maturity of the shell due to deposition of $CaCO_3$ and conchiolin and the light bands indicate growth check.

The shells consist of three layers—the outer organic layer,—Periostracan formed of *Conchiolin*. Beneeth the *Periostracum*—a Prismatic layer of columnar crystalline material is seen formed of $CaCO_3$ and lastly the inner layer of cells, that form Nacre or 'Mother of Pearl'. Periostracum and conchiolin of prismatic layer are secreted from the edge of mantle cavity spreading over the whole of its outer surface.

Teissier (1948) has shown that the slope of functional line denotes the ratio of the standard deviations of Y and X. It is also the geometric mean of the ordinary regression of Y on X and the reciprocal of regression of X and Y (or vice versa) and for that reason it has been called the geometric mean (GM) of functional regressions.

Length (L) vs breadth of the shell (B) :

This relationship obeys the following equation :

$$B = 0.719589\ L^{0.948596}$$

The regression analysis ($b = 0.948596 < 1$; $r = 0.917939$, $p < 0.001$) is performed, shows higher degree of relationship between length and breadth of the shell of Bivalve *(P. favidens)*. But regression coeff. (b) tells us that breadth will decrease in size relative to the length, which is quite evident from our experimental outcomes.

Length (L) vs Flesh weight with shell (W) :

The regression analysis ($b = 3.11047173 > 3$; $r = 0.972453$, $p < 0.001$) has been performed between two variables, shows strong relationship :

$$w = 0.149541 . L^{3.110471}$$

Regression coeff. (b) shows its closeness to cube law of growth of animals, which indicates that the Bivalve *(Parreysia favidens)* is increasing in its flesh weight with shell at a greater rate than required to mantain constant body proportion, and vice versa.

Length (L) vs Flesh weight without shell (W') :

The correlation coff. ($r = 0.98511$, $p < 0.001$) and regression coff. ($b = 3.676332 > 3$) were computed between length and flesh weight without shell and found highly significant at 0.1% level. There is a positive and strong relationsgip between two variables. b-value (>3) indicates that the increase in flesh weight without shell (three dimensionally is at a very faster rate than required

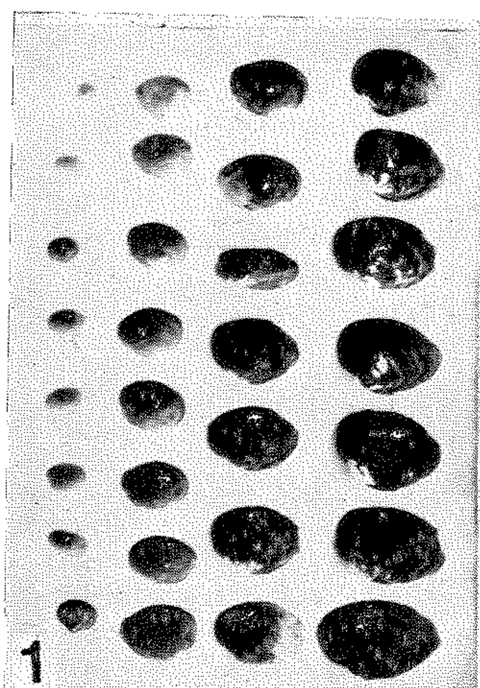

Fig. 1 : Light photograph of group of small and large specimens of *Parreysia favideny* (body weight : 0.21 gm to 9.7 gm).

Fig. 2 : Photograph of a large specimen showing growth rings in the form of dark and light bands on the shell of *Parreysia favidens*.

to maintain stable body proportions and vice versa. Its most probable functional relationship may be expressed as :

$$w' = 0.016876.\ L^{3.676832}$$

Length (L) vs Dry weight of the entire flesh (DW) :

The regression analysis ($b = 2.91822$, $r = 0.846156$, $p < 0.001$) was performed to get an appropriate model between two variables. The significant value of 'r' suggests that the increase in length of Bivalve *(P. favidens)* causes the increses of dry weight of the entire flesh, its b-value shows that dry weight of entire flesh weight is increasing at greater rate compared to its length but not as faster rate as in the case of flesh weight without shell, which is due to lack of shell and of moisture. Its functional relation may be written as

$$DW = 0.315211\ .\ B^{2.918222}$$

Breadth (B) vs Flesh weight with shell (w) :

The correlation coefficient ($r = 0.937357$, $p < 0.001$) and regression coeff. ($b = 2.901316 < 3$) were computed between breadth and flesh weight with shell, which were found highly significant at 0.1%. It concludes that increase in breadth of the Bivalve *(P. favidens)* causes the increase in the flesh weight with shell. Whereas the value of regression coefficient pointed out that per unit change in breadth, flesh weight with shell increases by 2.901316. Its probable functional relation may be expressed as :

$$W = 0.562109\ .\ B^{2.901316}$$

Breadth (B) vs Flesh weight without shell (W') :

The positive and highly significant correlation coefficient ($r = 0.922055$, $P < 0.001$)

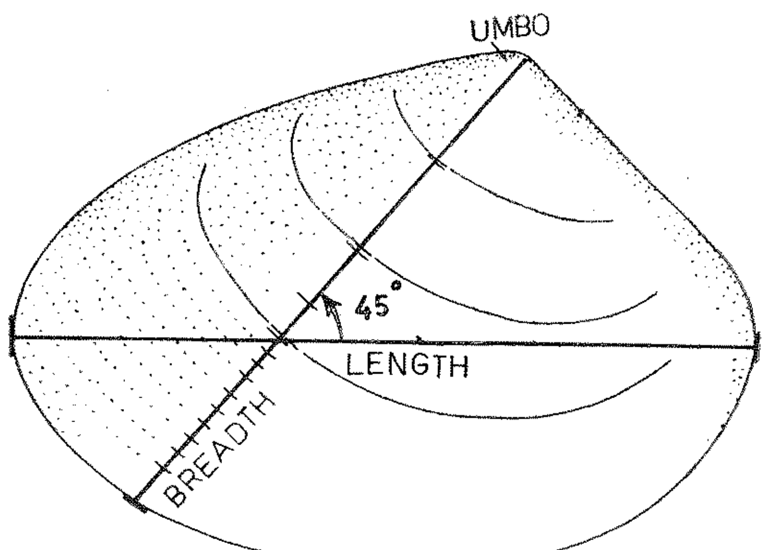

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Fig. 3 : Diagram of a shell of *Parreysia favidens* indicating the length and breadth dimensions of the shell. The breadth line originating from Umbo cuts the length line 45°, but the growth lines at 90°.

was observed between breadth and flesh weight without shell.

$$W' = 0.86088.\ B^{3.329802}$$

Breadth (B) vs Dry weight of entire Flesh (DW) :

The regression analysis ($b=2.892985<3$, $r=0.866853$, $p<0.001$) was also performed between two variables which shows that it is not very much close to the cubic law. But it gives an idea that in absence of moisture flesh weight is not growing at much faster rate as compared to the flesh wt with shell. And its probable model may be written as :

$$DW = 0.027349.\ B^{2.892985}$$

Two different types of growth in animals have been recognized,—Isometric and Allometric growth.

Isometric Growth : When $b=1$, growth is isometric (Gk. isos, equal ; metron, measure) because the growth of the body parts are growing proportionally.

Allometric Growth : When $b > 1$ or < 1, growth is allometric (Gk. allos, other, metron, measure) differencing in their growth rates. There change of proportion with increase of size, the growth rate of a part differencing from the growth rate of the whole. In such cases of heterogony (dysharmony), the change of weight W is increasing faster or slower than L.

Zar (1968) and others have pointed out that fitting growth by least squares is not the same thing as obtaining a least squares fit to eq^n . . (1). There is a general tendency for natural variability to increase as size increases, so that the logarithmic transformation tends to stabilize variance and so make a least squares fit more appropriate. Variability in the data will be almost entirely natural, with very little contribution from errors in measurements, and the body parts measured cannot be categorized as 'dependent' and 'independent'. Hence the line must be fitted symmetrically with respect to both variables, and this requires a functional regression. The magnitude of the correlation coefficient between W and L indicates the difference between two regressions (Functional and Ordinary).

When comparing weight and length the situation is similar. A functional slope or exponent, $b=3$ of the line log W and log L indicates isometric growth in which weight increases as cube of the length. When $b>3$ the bivalve is increasing in weight (Presumably also in volume) at a greater rate than required to maintain constant body properties and vice-versa.

Lumer (1937) pointed out that eq^n . . (1) implies that the instantaneous rates of increase in the lengths of two body parts must either remain constant or change at the same instantaneous rate b, the exponent indicates the direction and speed of any change in body form. Whereas Le Cren (1951) has marked that the Weight/Length relationship in fish may be expressed by eq^n. . (1) , Where, 'a' is constant and 'b' is an exponent usually lying between 2.5 and 4.0.

Acknowledgements

The authors are thankful to Indian Council of Agricultural Research, New Delhi for providing financial assistance (Grant No. 4 (4)/89—ASR (I)).

References

Datta Munshi, J. S. and Choudhary, L. K. (1987): Exploitation and conservation of Shell Fisheries in the Ganga river drainage system and the present status of Mother of Pearl button Industry of Bihar, Proc. Sem. State Environ., Bhag. Univ. pp. 18-21.

Datta Munshi, J. S., Singh, D. K., Thakur, P. K. (1991): Food and feeding habits of a freshwater bivalve, *Parreysia favidens* (Benson) from the Kosi river system. J. Freshwater Biol. 3 (4): 287-293.

Datta Munshi, J. S. and Pandey, Anita (1991): Respiration metabolism and scanning electron microscopy of the gills of freshwater riverine mussel *Parreysia favidens*. J. Freshwater Biol. 3 (1): 65-70.

Huxley, J. S. (1932): *Problems of relative growth*. Methuen, London.

Le Cren, E. D. (1951): The Length-Weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). J. Amer. Ecol. 20: 201-219.

Lumer, H. (1937): The Consequences of Sigmoid growth for relative growth functions. Growth, 1: 140-154.

Teissier (1948): La relation d'allometries: sa signification statistique et biologique. Biometrics 4: 14-18.

Thompson, D' Arcy W. (1942): *On the grow h and form* Vol. I and Vol. II. Cambridge University Press, Cambridge.

Zar, J. H. (968): Calculation and miscalculation of the allometric equation as a model in biological data. Bioscience. 18: 1118-1120.