International Journal of Aquatic Science
ISSN: 2008-8019
Vol 3, No 1, 2012

Length weight relationship and relative condition factor of *Schizopyge esocinus* (Heckel, 1838) from Jhelum River, Kashmir

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Abstract: The length-weight relationship of *Schizopyge esocinus* were calculated for males, females. The relationship was analyzed using the formula $W = a L^b$ which was further transformed into Log W = a+b logL. A total of 582 specimens comprising 277 males, 305 females with different size groups. The equation obtained for males was; log W = - 4.1567 + 2.897 logL; for females: logW = - 4.5089 + 2.8618 logL; The regression coefficients between males and females did not show any significant difference while significant difference could be noticed between males and between females ($p < 0.01$). Studies on relative condition factor (Kn) of *Schizopyge esocinus* revealed that the fluctuations in 'Kn' values can be attributed to spawning cycle as well as feeding intensity.

Key Words: Length-weight relationship, condition factor, *Schizopyge esocinus*

Introduction

Among Schizothoracids, *Schizopyge esocinus* (Snow trout) is the most important food fish from commercial point of view. Snow trout fetches more economic returns to the fishermen community in Kashmir (India). Moreover, it could also be included in the aquaculture programme along with common carp, grass carp, silver carp, etc. Studies on length- weight relationship are of considerable importance in fishery because it shows relevance to fish population dynamics and pattern of growth on fish stocks. Growth is defined as the change in size with reference to time. Weight of a fish is expressed as a function of length. Knowledge of length-weight relationship is of paramount importance in fishery biology as it serves several practical purposes. The general length-weight relation equation provides a mathem-aticcal relationship between the two variables, length and weight, so that the unknown variable can be easily calculated from the known variable. This expression had been extensively used in the study of fish population dynamics for estimating the unknown weights from known lengths in yield assessments (Pauly, 1993), in

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setting up yield equation for estimating population strength (Beverton & Holt, 1957l; Ricker, 1958), in estimating the number of fish landed and in comparing the populations over space and time (Chanchal *et at.*, 1978). It also yields information on growth, gonadal development and general condition of fish (Le Cren, 1951) and therefore, useful for comparison of body forms of different groups of fishes. The length-weight relationship has a biological basis also as it depicts the pattern of growth of fishes. According to the general cube law governing length-weight relationship, the weight of the fish would vary as the cube of length. Le Cren (1951) proposed relative condition factor (Kn) in preference to 'K' as the former considers all the variations like those associated with food and feeding, sexual maturity, etc., while the latter does so only if the exponent value is equal to 3. Thus 'K' factor measures the variations from an ideal fish, which holds the cube law while 'Kn' measures the individual deviations from the expected weight derived from the length-weight relationship.

The length-weight relationship of cyprinids from India has been studied by many. Some of the recent studies in this line are that Mohan & Sankaran (1988), Kurup (1990), Reddy & Rao (1992), Biswas (1993), Pandey & Sharma (1997), Sarkar *et al*. (1999) , Sunil (2000) and Geol *et al* (2011). *Schizopyge esocinus* commonly known as Snow trout is an endemic carp fishery of River Jhelum of Kashmir valley. Snow trouts are highly preferred to the local masses because of its food value and taste that fetches high price market (Singh and Paul, 2010). In comparison to other members of genus *Schizopyge*, this species attains big size. Even though studies on food and feeding, maturation, spawning and age and growth of this species revealed its good aquaculture potential as a better substitute for grass carp in composite fish culture. No information is available so far on the length-weight relation-ship and condition factor of *Schizopyge esocinus* and therefore, the present study was under taken to establish the pattern of growth and general condition of this fish species from the natural waters for direct use in fishery assess-ment.

Material and Methods

A total of 582 specimens of, comprising 277 males and 305 females were collected from district Srinagar of river Jhelum during May 2006 to April 2007. After removing the excess water on the specimens by pressing with blotting paper, the total length at the nearest millimetre and weight to the nearest 0.01 gram were recorded. Total length was measured from the tip of snout to tip of the longest ray in caudal fin (Jayaram, 1999). Total length of male and female varied from 180 to 430 mm, 174 to 447 mm respectively. The weight varied

from 165 to 635 g in males, 180 to 753 g in females. The data so generated were subjected to statistical analysis by fitting length-weight relationship following Le Cren (1951). Length - weight relationship can be expressed as $W = aL^b$, the logarithmic transformation of which gives the linear equation

$LogW = a + b\ logL$

Where W = Weight in gram, L= length in mm,

a = a constant being the initial growth index,

and

b = growth coefficient.

Constant 'a' represents the point at which the regression line intercepts the y-axis and 'b' the slope of the regression line.

The relationship between length and weight was determined for males and females separately by transforming the values of both variables to logarithamatic values and fitting a straight line by the method of least squares. The significance of regression was tested by ANOVA. The regression coefficients for male and female were compared by analysis of covariance (ANACOVA) (Snedecor & Cochran, 1967) to establish the variations in the 'b' values, if any, between them. Bailey's t-test (Snedecor & Cochran, 1967) was employed to find out whether 'b' value significantly deviated from the expected cube value of 3 [t = (b-3)/Sb], where b = regression coefficient and Sb = Standard error of 'b'. The t-test (Snedecor & Cochran, 1697) on 'r' values reveals whether significant correlation exists between length and weight.

Relative condition factor (Kn) as per Le Cren (1951) is expressed as follows:

$Kn = W / \hat{}W$

Where W = observed weight

$\hat{}W$ = calculated weight derived from length-weight relationship.

Results

Length- weight relationship of males and females *Schizopyge esocinus* can be expressed as follows:

Males: $logW = -4.1567 + 2.897\ logL$

Females: $logW = -4.5089 + 2.8618\ logL$

The 95% confidence limits of 'b' values were:

Male: 2.4705 to 2.959

Female: 2.5386 to 3.1850

The correlation coefficient 'r' between log length and log weight was found to be 0.8705 in males, 0.8849 and in females. The 't' test on 'r' values (Table 1) showed the existence of good relationship between length and weight ($p<0.01$). The results of ANOVA on the length-weight regressions were found to be highly significant in both the sexes Based on the coefficient of determination (r^2) (Croxton, 1953), 76% of the variation in weight in males, 75% in females were found to be associated with the change in the length of the fish.

Table 1. Statistical details showing number of fish studied (n), intercept (log a), regression coefficient (b), standard error of b (sb) and results of Bailey's t-test on 'b' and t-test on correlation coefficient (r), (P<0.01)

Sex	N	log a	b	sb	t	p	r	p
Males	222	-4.1567	2.7148	0.1236	2.3	<0.05	0.8705	22.65
Females	182	-4.5089	2.8618	0.163	0.8	-	0.8849	20.1

The results of analysis of covariance (ANACOVA) revealed significant difference in the regression coefficient of males and females (F value = 69.04, df: 2, 1102) thereby indicating heterogeneity of the samples. Hence, pair-wise comparison between males and females were carried out using Students 't' test (Zar, 1974). The results revealed no significant difference between 'b' values of males and females (t = 0.7, df: 257). The comparison of elevations disclosed significant difference among the three groups (p<0.01). Hence, pooling of data to provide a single equation expressing the length-weight relationship of *S. esocinus* will not be justifiable, thus necessitating fitting up of separate equations for males and females.

The results of Bailey's 't' test revealed significant departure of 'b' value from the hypothetical value of '3' in males. While no significant difference could be noticed in females. The 't' test arrived at, 2.3 (df: 152) in males manifested the significant departure of 'b' value from 3 (p<0.05). In females 't' value was 0.8 (df: 103) which was non-significant.

In the present study, the highest 'b' value arrived at in females of *Schizopyge esocinus* implies that the females gain weight at a faster rate in relation to its length. The 'b' value of males indicated negative allometry, which indicates that, the increase in length is not in accordance with increase in weight.

Reports on the length-weight relationship of cyprinid fishes showed that many of them strictly follow cue law while there are many in which the weights of fishes either tend to increase or decrease in proportion to the cube of length. Isometric growth pattern has been reported in *Catla catla* (Choudhury *et al* 1982; Kartha & Rao, 1990) and *Schizopyge plagisotomus* (Bhagat & Sunder, 1983). All these earlier reports are in compliance with the present findings on the length-weight relationship in females of *S.esocinus* in which the 'b' value was very close to the isometric value of 3.

The slope value of regression line less than '3' has been reported in *Tor tor* (Malhotra, 1982), *Labeo dero* (Malhotra & Chauhan, 1984), *Labeo dyocheilus* (Malhotra, 1985), and *Cyprinus carpio communis* and *Ctenopharyngodon idella* (Dhanze & Dhanze, 1997) and *Rasbora daniconius* (Sunil, 2000). These reports corroborate with the present findings on the length-weight relationship in *S.esocinus*, in which significant departure of 'b' value from the isometric value of 3 was noticed in respect of both males.

Females of *Schizopyge esocinus* were found to surpass males in weight in relation to lengths as evidenced from the disparity in 'b' values. Similar trend has been observed in other cyprinids too viz, *L.fimbriatus* (Bhatnageinr, 1972) *L. dero* (Malhotra & Chauhan, 1984) *R. daniconius* (Thakre & Bapat, 1984) *L.dussumieri* (Kurup, 1990) and *Schizothorax richardsoni* (Geol *et al*. 2011)

Discussion

Le Cren (1951) reported that females are heavier than males of the same length probably because of difference in fatness and gonadal development. While discussing the seasonal effect on length-weight relationship of *Clarias batrachus*. Mitra & Naser (1987) found that higher metabolic activity with spawning season lowered the 'b' value while less metabolic activities, accumulation of fat, weight of gonad etc, during the prespawning period increased the values. The higher regression coefficients in female *Schizopyge esocinus* may be attributed to the higher fat accumulation and higher gonadal weight when compared to its male counterpart.

Beverton & Holt (1957) opined that since 'a' and 'b' of allometric formula might vary within a wide range for very similar data and are very sensitive to even slight variations in various factors, allometric formula worked better than cubic formula. Any indication in biological events could be recorded by allometric law. The significant departure of regression coefficients from the isometric growth value in male of *Schizopyge esocinus* indicate that the general parabolic equation $W = aL^b$ express the length-weight relationship in these groups better than the cube law while the cube law $W=aL^3$ holds good for the females of this species.

Fluctuations in the condition factor of many fishes were observed in relation to their reproductive cycle (Neelakantan & Pai, 1985; Narejo *et al*, 2002), feeding rhythms Sharma (1997) or physico-chemical factors of environment, age, physiological state of fish or some other unknown factors (Kurup and Samuel, 1987; Kurup, 1990; Kalita & Jayabalabn, 1997). The 'Kn' values in males showed a decreasing trend during June and from September to December. While in females, the relative condition factor decreased during May - June and September to December. This may be

attributed to the increased spawning strain in them, as o*pine*d by Menon (1950). Thus it appears that reproductive cycle in *Schizopyge esocinu*s is related to the variation in the condition factor.

In males, a 'Kn' value of 1.08 was worked out in 240-260 mm length group, followed by a decreasing trend in 260-280 and 280-300 mm size group. In 300-320 mm length group, the 'Kn' value increased up 1.1 and drop sharply to 0.94 in 340-360 mm length group.

Thereafter, the 'Kn' value increased and reached the highest value of 1.2 in 360-380 mm size class followed by a diminishing trend. In females, after reaching a 'Kn' value of 1.06 in 280-300 mm size class. It gradually decreased and attained the lowest value of 0.98 in 320-340 mm sixe class. Thereafter, the 'Kn' increased to a peak in 380-400 mm length class followed by gradual decline in the succeeding classes. In the case of Thereafter, the 'Kn' decreased to 0.96 in 180 -210 mm length class and reached the peak of 1.08 in 160-180 mm length class.

Sex-wise analysis of 'Kn' values revealed that the mean 'Kn' value in females (0.96) was higher than that of males (0.91). According to Le Cren (1951), 'Kn' greater than 1 indicated good general condition of fish. Pandey & Sharma (1997) studied the condition of four exotic carps and only the common carp, *Cyprinus carpio communis* was found to have value above 1 (1.0109). Pandey & Sharma, (1998) reported high 'Kn' values for *Labeo rohita* (1.0129) and *C. catla* (1.0007) and low values for *Cirrhinus mrigala* (0.9967).

It can be concluded that in *Schizopyge esocinus* females gain weight at faster rate in relation to its length when compared to males. Females of *Schizopyge esocinus* followed isometric pattern of growth whereas, males showed negative allometry. The study also revealed that in *Schizopyge esocinus*, though the condition of fish is more related to gonadosomatic index, there exists some relationship between relative condition factor and gastrosomatic index and other environmental and physiological factors.

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