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On the length-weight relationship of the little-known lesser spiny eel, *Macrognathus aculeatus* (Bloch) (Pisces: Mastacembelidae)

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Abstract. The length-weight relationship was computed independently for males and females of *Macrognathus aculeatus*. The analysis of covariance revealed no significant difference ($p = 0{\cdot}05$) between the length-weight relationship of males and females. Hence, a common logarithmic equation ($\log W = -5{\cdot}6934 + 3{\cdot}1234 \log L$) was fitted for the species. The regression coefficient of logarithm of weight on logarithm of length was found to depart significantly ($p = 0{\cdot}05$) from the cubic value.

Keywords. Length-weight relationship; *Macrognathus aculeatus;* logarithmic equation; regression coefficient; cubic value.

1. Introduction

The mathematical relationship between length and weight of fishes and its vital importance in fishery is well known to fishery biologists. The study of length-weight relationship provides information to measure variation from the expected weight or length of individual fish or group of fish as indicative of fatness, general well-being or gonad development (Le Cren 1951). This is of primary importance in computing the yield equations (Ricker 1958), in estimating the number of fish landed and in comparing populations in time and space (Chanchal *et al* 1978). Of the two measurements, i.e., length and weight, the former is more easily measurable and can be converted into weight, in which the catch is invariably expressed (Bal and Rao 1984).

Macrognathus aculeatus (Bloch) inhabits freshwater streams, ponds and tanks. They attain upto 15 inches in length and are excellent as food (Day 1878). As they are often found in pieces of water in which mud abounds, they are popularly known as the 'ditch eels' (Hora 1935). They are also known as the 'lesser spiny eels' (Munro 1955).

Though *M. aculeatus* is found to be a commercially important species, there is no information on its biology. Therefore, an attempt has been made to study its length-weight relationship, with the two-fold aim of determining (i) whether the length-weight relationship differs between the sexes, and (ii) whether the coefficient of regression of logarithm of weight on logarithm of length departs significantly from the cubic value.

2. Materials and methods

The length-weight relationship was based on the data obtained from a total of 110 fishes, comprising 25 males (153–225 mm in total length) and 85 females (170–317 mm in total length), collected in fresh condition from the local fish market at Tambaram during May 1984–June 1985. The total length of the fish was measured from the tip of the snout to the tip of the tail and expressed in mm. The body weight was recorded to

the nearest 0·001 g. As there was no sexual dimorphism, the fishes were dissected and sex was determined.

The length-weight relationship was calculated by employing Le Cren's (1951) hypothetical formula: $W = aL^n$ and its logarithmic form: $\log W = \log a + n \log L$. The regression of logarithm of weight on logarithm of length of males and females was tested by analysis of covariance (Sokal and Rohlf 1969). The *t*-test (Sokal and Rohlf 1969) was employed to test whether the regression coefficient departs significantly from the cubic value.

3. Results

The observed values of length and weight of *M. aculeatus* were plotted (figure 1). The parabolic equations obtained were:

Males: $W = 0{\cdot}00000152229\ L^{3{\cdot}1663}$
Females: $W = 0{\cdot}00000466015\ L^{2{\cdot}9712}$

Similarly, the logarithmic values of observed length and weight were plotted (figure 2). The regression lines fitted to the data indicate straight line relationship

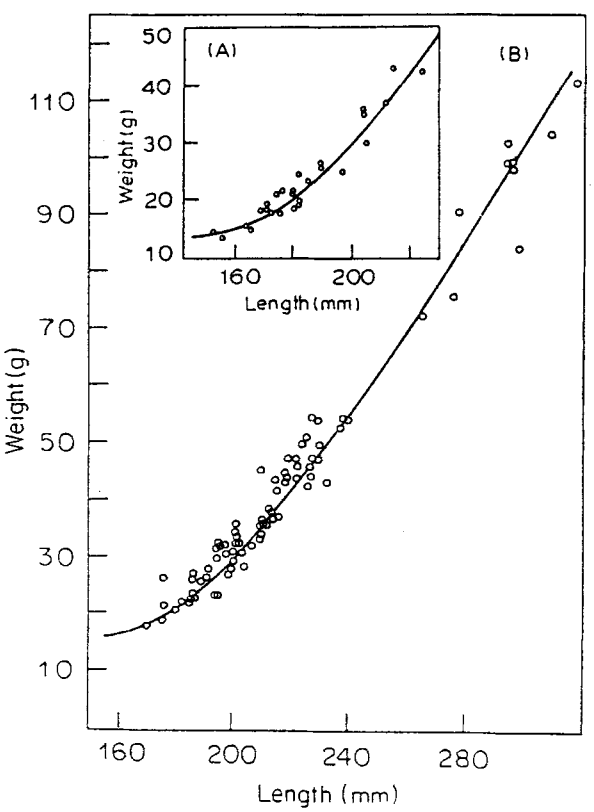

Figure 1. Observed values of length and weight of *M. aculeatus*. (A) Males; (B) Females.

between the two variables. The logarithmic equations obtained were:

Males: $\log W = -5{\cdot}8175 + 3{\cdot}1663 \log L$
Females: $\log W = -5{\cdot}3316 + 2{\cdot}9712 \log L$

Analysis of covariance revealed no significant ($p = 0{\cdot}05$) difference between the sexes (tables 1–3). This has justified the pooling of data of the two sexes to obtain the following common equations for the species:

Parabolic equation: $W = 0{\cdot}00000202581\ L^{3{\cdot}1234}$
Logarithmic equation: $\log W = -5{\cdot}6934 + 3{\cdot}1234 \log L$.

The *t*-test revealed that the value of regression coefficient (3·1234) obtained for this species departed significantly from the cubic value (3) at 5% level with 108 df.

4. Discussion

For fishes, the relationship between length and weight could be expressed by the hypothetical cube law: $W = c\ L^3$, where 'W' represents weight of the fish, 'L' its length and '*c*' a constant. Le Cren (1951), however, opined that it is better to fit a general

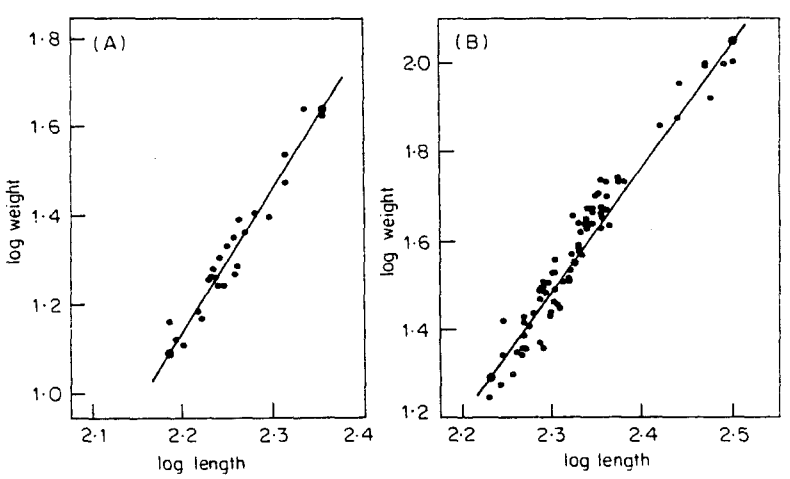

Figure 2. Logarithmic values of observed length and weight of *M. aculeatus*. (A) Males; (B) Females.

Table 1. Statistics of the length-weight relationship of males and females of *M. aculeatus*.

Sex	N	SX	SY	SX^2	SY^2	SXY
Male	25	56·4296	33·2360	127·4114	44·6108	75·1444
Female	85	197·6420	134·0447	459·8712	214·1631	312·6138

SX^2, SY^2, SXY, Sum of squares and products; SX, SY, Sum of logarithmic values of length and weight, respectively; N, Number of samples.

Table 2. Regression data of length-weight relationship of males and females of *M. aculeatus*.

		Sum of squares and products				Errors of estimate	
Sex	df	X^2	Y^2	XY	b	df	SS
Male	24	0·0394	0·4255	0·1246	3·1663	23	0·0309
Female	84	0·3183	2·7751	0·9330	2·9712	83	0·0398
	108	0·3577	3·2006	1·0576		106	0·0707

df, Degree of freedom; b, regression coefficient; SS, sum of squares.

Table 3. Test of significance.

Source of variation	df	SS	MS	Observed F	F = 0·05
Deviation from individual regression between sexes	106	0·0707	0·000666037		
Deviation between regressions	1	0·0016	0·0016	2·4024	3·92 Not significant
Deviation from total regression	107	0·0722			

parabolic equation of the form $W = a\ L^n$, where '*a*' is a constant equivalent to '*c*' and '*n*' is a constant to be determined empirically, i.e., from the data.

Presently, it has been found that the males increased in weight by an exponent (regression coefficient) of 3·1663 and females by 2·9712. Though the value of '*n*' was slightly higher in males than in females, this difference in exponent values was not significant ($p = 0·05$). However, similar higher values for males than females have been reported in the case of *Sardinella gibbosa* (Sekharan 1968), *Labeo calbasu* (Pathak 1975) and *Anabas testudineus* (Chanchal *et al* 1978).

For an ideal fish that maintains constant shape, the value of '*n*' will be 3 (Allen 1938), i.e., the weight will be proportional to the cube of length if the fish does not change form or density as it grows. Changes in morphology with advancing age may, however, cause the value of '*n*' to depart significantly from 3, so much so that the exponent '*n*' in the parabolic equation usually lies between 2·5 and 4·0 (Hile 1936; Martin 1949). Beverton and Holt (1957) stated that important deviations from isometric growth in adult fishes are rare. According to Ricker (1958), a good number of fishes approach ideal condition, though deviations from the hypothetical cubic value are not uncommon. A number of factors, viz gonad development, season, physiological condition of the fish at the time of collection and the nutritive condition of the water from which the fish were collected (Chanchal *et al* 1978) or food and feeding habits of the fish (Soni and Kathal 1979) may influence the value of '*n*'. Presently the value of regression coefficient obtained for *M. aculeatus* (3·1234), when subjected to the *t*-test, revealed that it did depart significantly ($p = 0·05$) from the cubic value (3). Deviations from the isometric value of 3 have been reported in many species of fishes (Jhingran 1962; Antony Raja 1967; Sinha 1972; Rangaswamy 1976; Rita Kumari and Balakrishnan Nair 1978; Nasar and Biswas 1982; Lazarus and Reddy 1986).

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