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Short Communication

Length-weight relationship of *Upeneus vittatus* (Forsskal, 1775) from the Gulf of Mannar coast (Mandapam, Tamil Nadu), India

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Length and weight relationship (LWR) provides vital information in fisheries biology. Length-weight relationship of *Upeneus vittatus* (Forsskal, 1775) were assessed during the study period from April 2012 to March 2013 in fresh condition separately for male and female from the Gulf of Mannar region. The LWR were significant ($P < 0.05$) for both male and female. Two different logarithmic equations were derived separately for males and females. Males: logW = -1.9262 + 3.0296 logL, Females: log W = -2.0287+3.1187 logL. The regression coefficient values of 3.02 and 3.11 were obtained for males and females, respectively.

[**Keywords**: Gulf of Mannar, Length-weight relationship, Regression coefficient, *Upeneus vittatus*]

Introduction

The family Mullidae is popularly known as red mullets or goatfishes. It comprises fifteen genera in which *Pseudopeneus*, *Upeneus* and *Mullus* are seen in Mediterranean Sea and other parts of the world[1,2]. Tropical, subtropical, Indo-Pacific and Western Atlantic regions of the world have significant amount of goatfishes. A total of 19 species of goat fishes are found along the Indian coast. Out of the 19 species, 18 are recorded from the western Indian Ocean[3]. Eleven species of goatfishes having commercial importance are landed along the Tuticorin coast of Gulf of Mannar[4]. Yellowstriped goatfish, *Upeneus vittatus* is one such commercially important demersal fish species of family Mullidae found along the Indian Ocean in depths less than 200 meters[5]. The study on LWR has a major role in population dynamics and fisheries science[6]. Calculating weights from the easily measurable lengths is very much utile in fishery studies because direct weight measurements in the field are more time consuming[7-9]. Knowledge of length and weight relationship of a fish in a particular geographic area is very useful for the following reasons: (a) to calculate the weight-at-age from the total obtained catch weight and length-frequency distributions; (b) to assess the condition of fish; and (c) to compare the life history of fishes between regions[10]. LWR is also useful to establish a mathematical relationship between these variables and also to calculate the variations from the assumed weight for length of individual or groups[11]. Length and weight relationship gets an important role in fisheries science involving several trends with fish life history[12].

In the years 1998-2000, the total catch of Yellow striped goatfish *U. vittatus* at Pamban and Mandapam landing centers were 23.9 and 14.6 % out of total goatfish catch, respectively[13]. Recent studies were reported on LWR of two goatfish species such as Cinnabar goatfish and Yellow striped goatfish from fishing harbour in the Tuticorin Coast[14]. In spite of good landing, not much scientific works are available on the life history traits and other related information of *U. vittatus*, hence it has been chosen for the present study. Further, LWR also plays a vital role in determining the suitable mesh size for capturing this species with respect to the marketable size and market demand which in turn will improve the efficiency of the effort of catch by reducing the chance of the by catch or untargeted species[15].

Various studies on length and weight relationships of various fishes have been carried out in the past from the Indian region *viz*. *Siganus canaliculatus* from Gulf of Mannar[16,17], *Sillago sihama* from Mandapam region[18], *Sphyraena abtusata* from Bombay waters[19], *Scarus ghobban* from Lakshadweep[20], LWR of *Trachinocephalus myops* from Chennai waters[21], *Lethrinus lentjan* and *L. nebulosus* from Thoothukudi coast[22], and *Scatophagus argus*[23] and *Upeneus vittatus* from Visakhapatnam coast[24], etc. The present assessment provides more information on LWR of *Upeneus vittatus* from Mandapam coast, Southeast coast of Tamil Nadu.

Material and Methods

The length and weight relationship presented in this study is based on the samples obtained from the

Mandapam landing centre (Gulf of Mannar) from April 2012 to March 2013. The samples were freshly collected and a graduated measuring scale (30 cm) was used to record the total length (TL) to the nearest mm (millimeter). Electronic balance (Shimadzu ELB 300 portable) was used to record the total weight of individual fish to the closest 0.1 g. Total length and corresponding weights of 124 fishes were recorded of which 45 were males and 79 were females.

The hypothetical formula, $W = aL^{b}$ (ref. 9) and its logarithmic form $\log W = \log a + b \log L$ were used to estimate the Length and weight relationship[25]. Where, W represents the total weight, L is the total length, "a" is the intercept, and "b" is the slope. The LWR helps to determine whether it is isometric growth (b = 3) or allometric growth (positive if b > 3 or negative if b < 3)[26,27]. The extent of association between the variables were computed by determining the regression coefficient (r^2) and its significance level and confidence limit of 95 % of parameters a and b were calculated[28].

Results

The length-weight relationships of 124 individuals of *Upeneus vittatus* collected from Mandapam landing centre during April 2012 to March-2013 were analyzed comprising of 45 males and 79 females. The sample size, minimum and maximum values of length and weight along with their mean values as well as the values of parameters a and b of length-weight relationship and the co-efficient of determination r^2 are presented in Table 1 separately for males, females as well as for the pooled samples.

The length and weight of the male fishes ranged from 7.6 to 17.3 cm and 5.6 to 71.0 g with the mean value of 13.14±2.21 cm and 31.61±15.45 g, respectively; whereas, the length and weight of female fishes ranged from 7.6 to 19.6 cm and 4.0 to 104.5 g with the mean value of 13.82±2.45 cm and 37.31±19.47 g, respectively. Similarly, the length and weight of pooled samples ranged from 7.6 to 19.6 cm and 4.0 to 104.5 g with the mean value of 13.57± 2.38 cm and 35.24±18.26 g, respectively.

The exponent *b* of length-weight relationship of male was 3.02 and 3.11 for female, whereas it was 3.06 for pooled samples. The LWR for males, females and the pooled samples were significant ($p < 0.05$) for *Upeneus vittatus*. The regression coefficient of males, females and the pooled samples did not depart from the cubic value of 3 at 5 % level. The results proved that the pooled samples, females and males showed an isometric growth (b = 3). The b values falling between 2.5 and 3.5 agreed with the results of previous reports[9,29]. This is mostly caused due to the fishes with narrow size ranges[30].

The obtained and the computed values of length and weight for males, females and for the pooled sample data of *U. vittatus* are given in Figures 1(a – c) and the data showed a strong association between the observed and the calculated values. The logarithmic equations derived for males, females and the pooled samples were given below:

Males : $\log W = - 1.9262 + 3.0296 \log L$

Females : $\log W = - 2.0287 + 3.1187 \log L$

Pooled samples : $\log W = - 1.9917 + 3.0658 \log L$

Whereas, the parabolic equations were derived as:

Males : $W = 0.1185^{L3.0296}$

Females : $W = 0.0093^{L3.1187}$

Pooled samples : $W = 0.0101^{L3.0658}$

Discussion

For an ideal fish with dimensional equality the *b* value should be 3. The slope with *b* value lesser to 3 denotes the fish is more slender with the increase in length. If the slope value is greater than 3, the fish would be stouter or with an allometric growth[31]. Common anticipation is that the fish weight varies as the cube of its length[32]; however the *b* values usually fall between 2.5 and 4 (ref. 29). It is agreed that the *b* value is mostly near to 3 when a cubic relationship between the length and weight exist[33]. Maximum number of species showed this ideal value of 3 which agrees with previous reports[34]. The combined LWR equation for *U. vittatus* showed a negative allometric

Table 1 — Statistical description of LWR parameters of *Upeneus vittatus*

Sex	N	Length (cm)			Weight (g)			Parameters of LWR			Growth type
		Min	Max	Mean±S.D	Min	Max	Mean±S.D	*a*	*b*	r^2	
Male	45	7.6	17.3	13.1±2.21	5.6	71.0	31.6±15.45	0.0118	3.02	0.97	I
Female	79	7.6	19.6	13.8±2.45	4.0	104.5	37.3±19.47	0.0093	3.11	0.97	I
Pooled	124	7.6	19.6	13.5±2.38	4.0	104.5	35.2±18.26	0.0101	3.06	0.97	I

N - Sample size, *a* - intercept of regression curve, *b* - growth coefficient, r^2 - determination coefficient

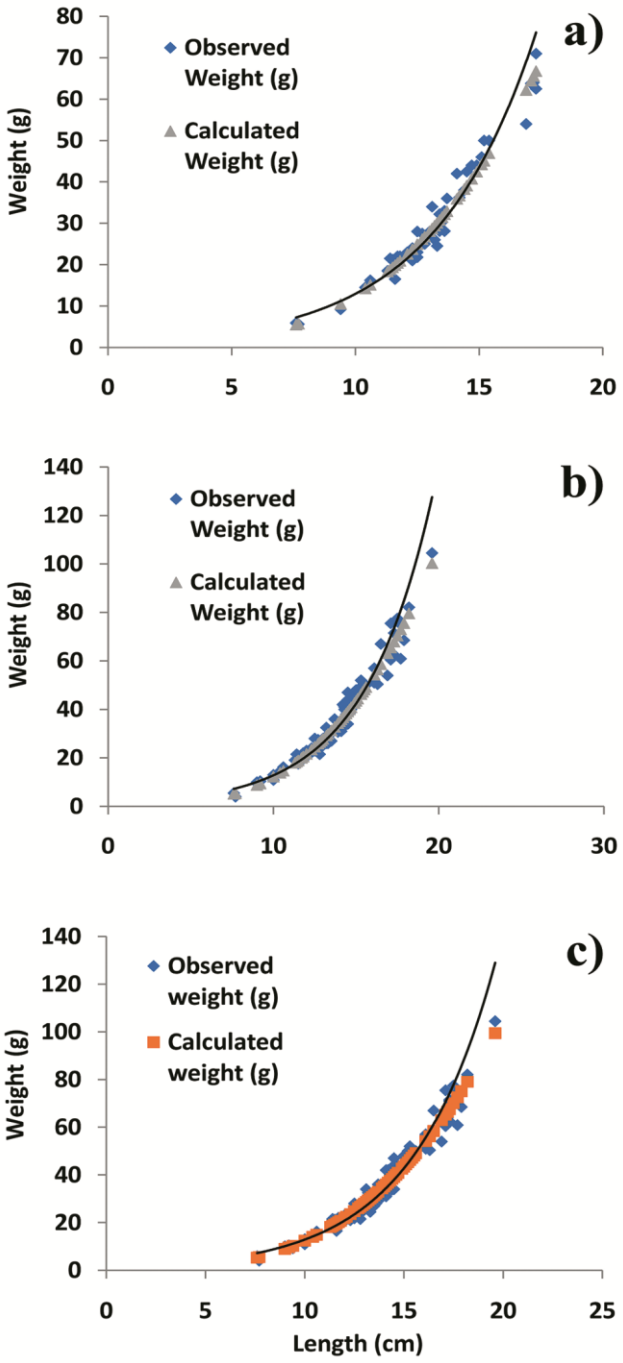

Fig. 1 — Relationship between length and weight (observed and calculated): a) Males, b) Females, and c) Pooled samples

growth pattern which differs from the results obtained in the current study[35].

Combined LWR equations for *U. moluccensis* and *U. pori* were derived by Taskavak & Bilecenoglu[36] and reported isometric growth for *U. moluccensis* and a positive allometric growth for *U. pori*. Separate length-weight relationship equations for males and females of *U. moluccensis* showed an isometric growth pattern in both sexes[37]. Contrasting to this, separate equations for males and females of *U. sulphureus* did not show an isometric growth for both the sexes[38]. Similar to the present study, an isometric growth (3.309) was reported in *Upeneus vittatus* from New Caledonia[39].

In the present study, the *b* values obtained for males (3.0296), females (3.1187) and for the pooled samples (3.0658) indicated an isometric growth in this geographical area similar to the previous reports[10]. The females grow larger than the males generally due to their large ovary size and this is the reason for increased *b* values in female fishes. The energy obtained by food and oxygen intake by female fishes was not spent on fights with other fishes or for reproduction which a male fish usually do, hence the females easily outgrow the male in size which is clear as there is an increase in *b* value of females[40]. Separate equations for males and females of *U. vittatus* off northeast Indian coast showed the similar results[41]. The *b* value 3.0658 of combined LWR is almost similar with the value reported by Rajkumar[24] which was 2.99. Moreover, separate LWR equations for males and females of *U. pori* showed an isometric growth[42] similar to the current study.

Conclusion

The present investigation revealed that both the males and females of *U. vittatus* collected from Mandapam landing centre showed an isometric growth, which means the weight increases proportionally to the cube of the length as the exponent value observed was almost 3. This in turn reveals that the Gulf of Mannar region is suitable for good growth of *U. vittatus* although the population of *U. vittatus* is reduced along the Southeast coast of India due to over fishing and further steps have to be taken to conserve the innate species.

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Conflict of Interest

The authors declare no conflict of interest

Author Contributions

ARL: Performed the experiments, analyzed and interpreted the data and wrote the paper; MA:

Conceived and designed the experiments, analyzed and interpreted the data; and KR: Analyzed and interpreted the data, edited and reviewing the article.

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