

# Length-Weight Relationship and Relative Condition Factor of *Coilia Dussumieri* (Cuv. & Val.) from Neretic Waters off the Mumbai Coast

Hitesh U. Shingadia

Dept. of Zoology, SVKM's Mithibai College of Arts, Chauhan Institute of Science and Amrutben Jivanlal College and Economics, Vile Parle - West Mumbai 400 056 Maharashtra India

**Abstract:** Morphometric studies are essential to determine the growth form and growth rate of a species, which is very much important for proper exploitation and management of the population of a species. The length-weight relationship & relative condition factor were computed for the Anchovy *Coilia dussumieri* (Cuv. & Val.). A total of 154 individuals (124 males & 30 females) were used for the study. The 'b' value shows significant correlation between length & weight of fish. The values obtained for mean weight by sex show that females were significantly ( $P < 0.05$ ) larger than males. The relative condition factor showed seasonal variation in both the sexes. Observation also suggests that female fish are generally better conditioned than the male fish. The lowest condition factor signifies that the fish is in breeding season with higher body weight. Hence fishing operations should be suspended during this period to have recruits for the next fishing season. The regression equation of wild *Coilia dussumieri* showed symmetrical growth in relation to body form. Thus the weight-length relationship is an useful tool in fish biology, physiology, ecology and stock assessment.

**Keywords:** *Coilia dussumieri*, Length-Weight relationship, Relative condition factor

## 1. Introduction

Anchovies are the members of the Family: Engraulidae (Francis Day, 1896) forming significant catch of the marine fish landed along the North-West Coast of India viz. Maharashtra & Gujarat. The gold spotted grenadier anchovy *Coilia dussumieri* (Cuv. & Val.), locally called 'mandeli' in Maharashtra form one of the fishery bycatch. Though it does not form the commercially important marine fish landing, it is caught along with a variety of other fish in bag nets & trawl nets in fairly large amount. *Coilia dussumieri* (Cuv. & Val.) in local fish market is sold in clusters in fresh condition; however a large portion is preserved by sun drying. It forms one of the low priced favourite fish commodities of the local populace of Maharashtra & Gujarat. The stock is concentrated along the North-Western Coast of India between 19°N & 21°N latitudes & 71°E & 73° E longitudes (Fernandez & Devraj 1988). Many Fishery Biologists in past have studied some aspects of *Coilia dussumieri* (Cuv. & Val.); Palekar & Karandikar (1953) studied maturity stages of the fish from Bombay waters, Bal and Joshi (1956) and Gadgil (1965) presented general account of its biology from the Bombay waters. Fernandez and Devraj (1988) studied the stock assessment & dynamics of *Coilia dussumieri* (Cuv. & Val.) from the Exclusive Economic Zone along the North-Western Coast of India. However dearth of pertinent literature on morphometric aspects of fish from coastal waters of Mumbai for more than a decade led to probe into this investigation.

The study of length-weight relationship in fish helps to determine the mathematical correlation between two variables and to calculate the variation from the expected weight for length of the individuals of the fishes (Le Crens, 1951). Length-length relationships (LLRs) are important in fisheries management for comparative growth studies (Moutopoulos and Stergiou, 2002). Length-weight relationships (LWRs) are also useful in fishery

management for both in applied and basic use (Pitcher and Hart, 1982) to estimate weight from length observations, calculate production and biomass of a fish population and/or provide information on stocks or organism condition at the corporal level (Hossain et al., 2006). In tropical & subtropical waters the growth fluctuation is more frequent in fishes due to variation in seasons, multiple spawning & food composition (Das et al. 1997). The length-weight relationship helps to evaluate the condition, reproduction, life cycle & general health of the fish species (Pauly, 1993). The ratio of length to weight of fish is known to be a useful index of the condition of the fish & plays a significant role in fishery in monitoring sustainable yield. The relationship studies give important information in fishery assessment for predicting weight from length required yield assessment (Garcia et al. 1998). The measurement of growth as length & weight are highly correlative (Wotton, 1996). The length-weight relationship is an important tool in fish biology, physiology, ecology and fisheries assessment (Oscoz et al., 2005).

The condition factor is used to compare the condition, fatness or well being of the fish & is based on the hypothesis that heavier fish of a given length is better condition (Bagenal & Tesch 1978). Condition factor will help determine present and future population success by its influence on growth, reproduction and survival (Hossain et al., 2006). The length-weight parameters of same species may be different in the population because of feeding, reproduction activities, fishing, etc., which can be frequently used in the analysis of ontogenic changes. Furthermore, LWRs allow life history and morphological comparisons between different fish species or between fish populations from different habitats and/or regions. Therefore we need to know length-weight relationship of fish that are captured in the given place in a certain period of time. The study conducted for this purpose established length-weight relationship of *Coilia dussumieri* (Cuv. & Val.) from the coastal waters of Mumbai.

## 2. Materials and Methods

The random sample of fish *Coilia dussumieri* (Cuv. & Val.) were obtained from Versova fish landing centre from January 2009 to November 2009. A total of 154 specimens were analyzed for the biometric studies. The length-weight relationship was studied as per methods given by Biswas (1992) & in Practical Manual of Fish Biology (Jaiswar et al., 2004). Total length was measured using fish measuring board to the nearest millimeter & weight was measured by electronic balance of 0.1g accuracy. The total length & weight relationship was determined by equation  $W = aL^b$  given by Le Cren (1951), where 'a' is the intercept (initial growth coefficient) & 'b' is the exponent or the slope (growth coefficient). The equation was transformed into the logarithmic form,  $\text{Log } W = \text{Log } a + b \text{ Log } L$ . The values of 'a' & 'b' were determined empirically. The parameters a and b of LWRs were estimated by linear regression analysis (least-squares method) on log-transformed data. The allometry coefficient is expressed by the exponent b of the linear regression equation. Relative condition factor also called Fulton's Condition factor ( $K_n$ ) was determined by using equation,  $K = (W/L^b) \times 100$  as described by Le Crens, 1951 and Fulton, 1911; where K is condition factor, W is body mass and L is body length.

## 3. Results and Discussion

The length-weight relationship for *Coilia dussumieri* (Cuv. & Val.) ranging in size from 108 mm to 205 mm was estimated during the period of ten months from January 2009 to November 2009. From the results it is observed that weight of *Coilia dussumieri* (Cuv. & Val.) bears a curvilinear relationship with the length (Fig. 5) that becomes linear on logarithmic transformation (Fig. 1 & 4). The length & weight measurements of the fish are related to each other with a very high degree of correlation coefficient [Males,  $r^2=1.006$  & females,  $r^2=1.01$ , ( $P<0.05$ )]. According to Biswas (1992) if the value of 'r' is found to be higher than 0.5 the length-weight relationship is positively correlated. When average weight of different size groups of *C. dussumieri* (Cuv. & Val.) are plotted against average length of corresponding size groups, a parabolic curve is obtained, this suggest that weight of fish increases as power of length (Fig.5). The regression equation for both the sexes of *C. dussumieri* (Cuv. & Val.) are, Males:  $1.0 + 0.07 \text{ Log } L$ ; Females:  $0.6 + 0.072 \text{ Log } L$ . Equation  $W = a + bL^3$  was found to be the best fit to the length-weight data (Table 2). The value of exponent ('b') for males was 0.07 & for females was 0.072. The theoretical value of 'b' in length-weight relationship is reported as 3 (Cube's law), when body form of fish remains constant at different lengths i.e. the growth in fish is isometric (Allen 1938). In the relationships between different types of variables (linear and ponderal), LWRs reflects an isometric growth when  $b=3$ , i.e., relative growth of both variables is identical (Quinn II and Deriso, 1999). When  $b<3$  it can be said to have a negative allometric growth and is defined hypoallometry; instead when  $b>3$  it showed a positive allometric growth and is defined hyperallometry (Shingleton, 2010). In the present study exponential value indicates negative allometric growth pattern in *C. dussumieri* (Cuv. & Val.). The

comparable result showing allometric growth was reported by Nurul Amin & Zafar (2004) in *Coilia dussumieri* (Cuv. & Val.) from neretic waters from Bangladesh. LWRs are not constant over the year, varying with food availability and spawning period (Bagenal and Tesch, 1978), while the parameter b is characteristic of the species and generally does not vary significantly throughout the year (Bolognini et al., 2013). However Saravankumar et al. (2004) in flying fish *Exocoetus volitans* from Cuddalore waters of Tamil Nadu & Rajsegar (2005) in *Nemipterus japonicus* from Karaikkal coastal waters of Tamil Nadu reported isometric growth pattern. Mohanraj (2008) assessed the length-weight relationship of *Upeneus sundaicus* & *Upeneus tragula* from Gulf of Mannar & reported high significance in body weight & total length of both the sexes.

The Fulton's relative condition factor measures all variations associated with food supply sexual maturity etc. & hence tell us about the condition of fish in the environment. The study indicates inter-seasonal variation by change of weight in relation to length of fish (Table 1). The higher  $K_n$  value in males ( $K_n=0.521$ ) is indicative of increased deposition of fat as a result of adaptability & high feeding activity in male over female fish. Whereas lower  $K_n$  value in female ( $K_n=0.306$ ) indicate spawning periodicity of the fish. In terms of seasonality, K followed the reproductive cycle of fish, decreasing during the spawning season and increasing after it and well matched with their reproductive cycle described by several authors (Froese and Pauly, 2010). Sivashanthini & Abeyrami (2003) also reported higher relative condition factor for males than female silver biddy *Gerres oblongus* from Jaffna lagoon, Sri Lanka. Result of the present investigation showed significant relationship between length and weight of the *Coilia dussumieri*, which is applicable to assess the growth of the population as a whole.

## Acknowledgement

Investigator is grateful to the Principal and Management of S.V.K.M's Mithibai College for constant encouragement and support.

## References

- [1] Allen 1938. Some observations on the biology of trout (*Salmo trutta*) in Windermere. *J. Anim. Ecol.* 7: 333-349.
- [2] Bagenal T.B. and Tesch F.W. 1978. In: Methods for assessment of fish production in freshwaters, edited by T. B. Bagenal. IBP Hand book No.3. Third edition. Blackwell Scientific Publication, London: 101-136.
- [3] Bal D.V. & Joshi M.S. 1956. Studies on the biology of *Coilia dussumieri* (Cuv. & Val.). *Indian J. Fish.* 3 (1): 9-100.
- [4] Biswas S. P. 1992. Manual of method in fish biology. South Asian Publishers Pvt. Ltd. New Delhi.
- [5] Das N.G., Majumdar A. & Sarwar S.M.M. 1997. Length-weight relationship & condition factor of catfish, *Arius tenuispinis* Day 1877. *Indian J. Fish.* 44 (1): 81-85.

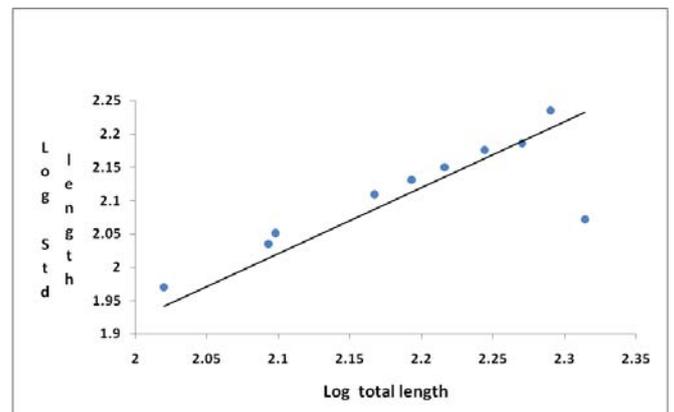
- [6] Day Francis 1896. The Fishes of India; Vol. 1. Jagminder Book Agency, New Delhi, India.
- [7] Froese, R., Pauly, D. 2010. FishBase. World Wide Web electronic publication. www.fishbase.org, version (11/2010).
- [8] Fulton, T. W. 1911. The sovereignty of the sea. London. Edinburgh. pp. 799
- [9] Gadgil M. D. 1965. On some aspects of *Coilia dussumieri* (Cuv. & Val.). University of Bombay. M.Sc. thesis.
- [10] Garcia C.B., Duarte J.O., Sandoral N., Von Schiller D., Melo G. & Navajan P. 1998. Length-weight relationship of demersal fishes from the Gulf of Salamanca, Columbia Naga. ICLARM Quarterly.16: 30-32.
- [11] Hossain M.Y., Ahmed Z.F., Leunda P.M., Jasmine S., Oscoz J., Miranda R. and Ohtomi J. 2006. Condition, length-weight and length-length relationships of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Mathabhanga River, southwestern Bangladesh. *J. Appl. Ichthyol.*, 22: 304-307.
- [12] Irene Fernandez and Devraj M. 1988. Stock assessment & dynamics of the *Coilia dussumieri* (Engraulidae) resource in the Indian Exclusive Economic Zone along the Northwestern Coast of India. *Asian Fisheries Science* 1: 157-164.
- [13] Jaiswar A., Chakraborty S. and Palaniswamy R. 2004. Practical Manual on Fish Biology. Central Institute of Fisheries Education (CIFE) publication, Padma Arts.
- [14] K. Saravankumar, Rajgopal S., Vijayanand P. and Yuvaraj D. 2004. Length-Weight relationship of flying fish *Exocoetus volitans* from Cuddalore waters of Tamil Nadu, India. *J. Aqua. Biol.* 19 (2): 45-47.
- [15] King R.P. 1965. Length-weight relationship of Nigeria coastal water fishes. *Naga ICLAMQ* 89: 53-58.
- [16] Le Cren E.D. 1951. The length-weight relationship & seasonal cycle in gonad weight & condition in perch (*Perca fluviatilis*). *J. Anim. Ecol.* 20. 201-219.
- [17] Luca Bolognini, Filippo Domenichetti, Fabio Grati, Piero Polidori, Giuseppe Scarcella, Gianna Fabi. 2013. Weight-Length Relationships for 20 Fish Species in the Adriatic Sea. *Turkish Journal of Fisheries and Aquatic Sciences* 13: 555-560.
- [18] Mohanraj J. 2008. Length-weight relationship of *Upeneus sundaicus* & *Upeneus tragula* from Gulf of Mannar. *Indian J. Sc. & Tech.* 1 (4): 1-6.
- [19] Moutopoulos D.K. and Stergiou K.I. 2002. Length-weight and length-length relationships of fish species from the Aegean Sea (Greece). *J. Appl. Ichthyol.* 18: 200-203.
- [20] Nurul Amin S.M. and Zafar M. 2004. Studies on age, growth & virtual population analysis of *Coilia dussumieri* from the neretic waters of Bangladesh. *Journal of Biological Sciences.* 4 (3): 342-344.
- [21] Oscoz J., Campos F. and Escala M.C. 2005. Weight-length relationships of some fish species of the Iberian Peninsula. *J. Appl. Ichthyol.* 21: 73-74
- [22] Palekar V.C. & Karandikar K.R. 1953. Maturity of *Coilia dussumieri* (Cuv. & Val.) in Bombay during different months of year. *J. Zool. Soc. India.* 5 (2): 217.
- [23] Pauli D. 1993. Fish byte section editorial Naga, the ICLARM Quarterly. 16: 26-27.
- [24] Pitcher T.J. and Hart P.J. 1982. Fisheries Ecology. Chapman and Hall, London.
- [25] Quinn II, T., Deriso, R.B., 1999. Quantitative Fish Dynamics. Oxford University Press, New York.
- [26] Rajsegar M. 2005. Length-Weight relationship of *Nemipterus japonicus* from Karaikkal Coastal waters, Tamil Nadu. *J. Aqua. Biol.* 20 (1): 25-26.
- [27] Shingleton A.W. 2010. Allometry: the study of biological Scaling. *Nature Education Knowledge*; 3 (10):2. www.nature.com/scitable/knowledge/library/allometry-the-study-of-biological-scaling-13228439; version (05/2013).
- [28] Sivashanthini K. & Abeyrami B. 2003. Length-weight relationship & condition factor of a silver biddy *Gerres oblongus* (Pisces: Perciformes) from Jaffna lagoon, Sri Lanka. *Indian J. Mar. Sc.* 32 (3): 252-254.
- [29] Wotton R.J. 1996. Ecology of teleost fishes. Chapman & Hall, London.

**Table 1:** Length-weight relationship Relative Condition Factor of *Coilia dussumieri* (Cuv. & Val.) from Mumbai Coast

Sex	N	r <sup>2</sup>	K <sub>n</sub>
Male	124	1.006	0.521
Female	30	1.01	0.306
Pooled	154	1.008	0.413

**Table 2:** Length-weight relationship of *Coilia dussumieri* (Cuv. & Val.) from Mumbai Coast and Regression equation

Sex	Regression equation	Exponent
Male	1.0 + 0.07 Log L	0.07
Female	0.6 + 0.072 Log L	0.072



**Figure 1:** Relationship between Log Total Length and Log Standard Length

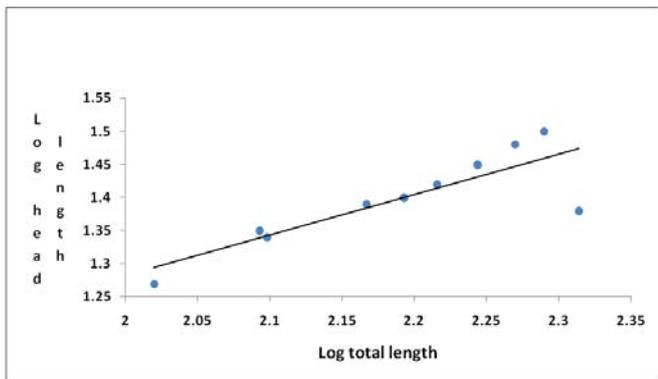


Figure 2: Relationship between Log Total Length and Log Head Length

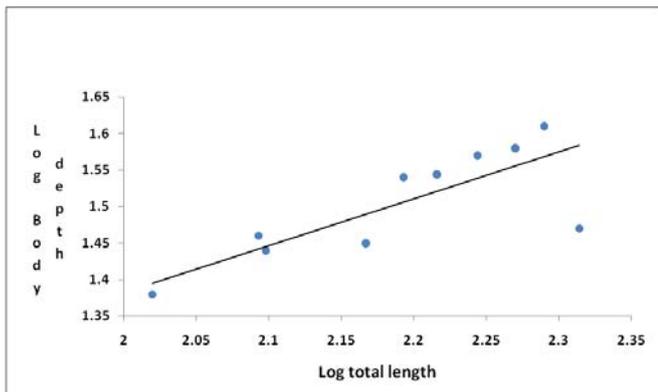


Figure 3: Relationship between Log Total Length and Log Body Depth

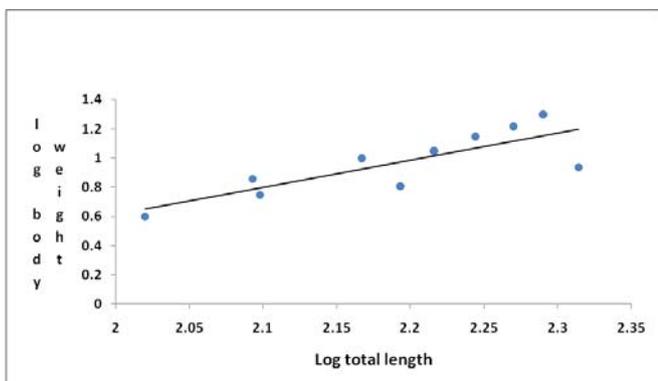


Figure 4: Relationship between Log Total Length and Log Body Weight

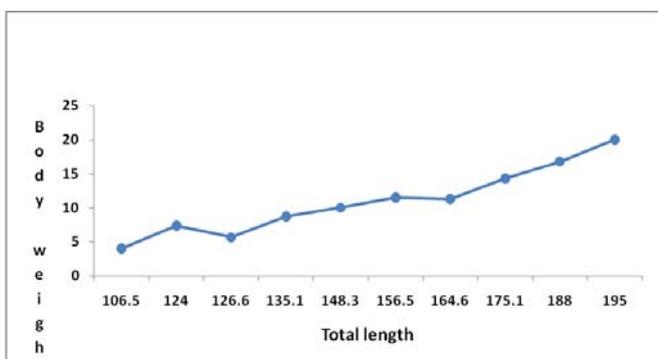


Figure 5: Relationship between Total Length and Body Weight

Author Profile



Dr. Hitesh U. Shingadia, M.Sc., Ph.D., is Assistant professor, Dept. of Zoology in Mithibai College Vile Parle - West Mumbai 400056. He has 17 Years of Experience. He has completed 04 Minor Research Projects of University of Mumba along with 12 years of Research Experience and 28 publications.