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# Length weight relationship and condition factor of *Hemiramphus archipelagicus* Collette and Parin, 1978 (family: Hemiramphidae) from Karachi Coast, Pakistan

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## Abstract
A study of the length weight relationship and condition factor of *Hemiramphus archipelagicus* from Karachi Coast was conducted from August 2010 to July 2011. Three hundred and Eighty five samples were collected by fishermen using gill net. The fish sample were preserved in formalin and taken to laboratory for identification and measurement of length and weight. Length- weight relationships (LWR) was described by the equation: $W = a L^b$. The highest and lowest values of the slope' b' in the length - weight relationship were observed in 2.87 and 2.55 and highest and lowest values of the intercept 'a' were observed in -1.577 and -1.023. The Correlation Coefficient of different size classes showed a very high degree of Correlation.

**Keywords:** Length-Weight relationship, Condition Factor, *Hemiramphus archipelagicus,* Karachi Coast, Pakistan.

## 1. Introduction
The length-weight relationships (LWR) have been applied for assessment of fish stocks and populations [1]. The length-weight relationships also helps to figure out the condition, reproduction history, life history and the general health of fish species [2, 3, 4, 5, 6] and is also useful in local and interregional morphological and life historical comparisons in species and populations [7, 8]. In fisheries the condition factor is used to compare the "condition", "fatness" or wellbeing of fish. And it is based on the hypothesis that heavier fish of a particular length are in a better physiological condition [9]. Condition factor has been used as an index of growth and feeding intensity [10]. Condition factor decreases with increase in length [11, 10] and also influences the reproductive cycle in fish [12]. The length-weight relationship of fish is an important fishery management tool. Its importance is pronounced in estimating the average weight at a given length group [13] and in assessing the relative well being of a fish population [14]. These data are needed to estimate growth rates, length and age structures, and other components of fish population dynamics [15]. Length weight relationships allow fisheries scientists to convert growth-in-length equations for growth-in weight in stock assessment models [16, 7, 17, 8, 18], estimate biomass from length frequency distributions [19, 16] and calculate fish condition [19]. Length-weight relationship plays a vital role in fisheries biology and population dynamics. It helps in estimating the standing stock or biomass thereby establishing the yield by converting one variable into another calculating condition indices, comparing the ontogeny of fish population from different regions [19] and in trophic studies [20]. According to [21] the weight of the fish proportionately increases to the length of fish. If the value of equilibrium constant is 3 it means fish obeys the cube law. But the physical and chemical factor affects the growth and changes the value of equilibrium constant 'b'. The aim of the present study is to determine the length weight relationships and condition factors of *Hemiramphus archipelagicus,* of Karachi Coast, Pakistan.

## 2. Materials and Methods
### 2.1 Study Area
Pakistan coastline admeasures 1,120 Km. with broads continental shelf. There are more than 16,000 fishing boats in the coastal area of Pakistan, which operate in coastal water as well as in offshore areas. Karachi is one of the major fish Harbour of Pakistan, handles about 90% of fish and sea food catch in Pakistan.

### 2.2 Sampling and Laboratory procedure

A total of 385 *Hemiramphus archipelagicus* samples were collected from fishermen at the landing site in Karachi fish Harbour from August 2010 to July 2011. These samples were caught by gill net of mesh sizes 60mm. The fish were examined fresh and kept in a deep freezer for subsequent examination. The sampled fish were identified in the laboratory of the Zoology Department, University of Karachi. The total length (TL) of the fish was measured from the tip of the anterior part of the mouth to caudal fin using meter ruler calibrated in centimeter. Fish weight of individual fish was measured to the nearest 'g' with an electronic balance after removing the adhered water and other particles from the body surface. The relationship between length and weight of fish was expressed by equation [22].

Where, $W = a L^b$

$W$ = Weight of fish in (g)

$L$ = Total Length (TL) of fish in cm

$a$ = Constant (Intercept)

$b$ = The length Exponent (Slope)

The a and b values were obtained from Linear regression of the length and weight of fishes.
The Condition factor (R) was determined using the expression as given by [23]

$$K = 100\, W/ L^3$$

Where, $K$ =Condition factor

$W$ =Weight of fish (g)

$L$ = Length of fish (cm)

**Table 1:** Length and Weight distribution of *Hemiramphus archipelagicus* of Karachi Coast.
N = Number, Min = Minimum, Max = Maximum, SD = Standard Deviation.

| Length groups (cm) | | | | Total length (cm) | Body weight (g) | | |
|---|---|---|---|---|---|---|---|
| | N | Min | Max | Mean ± SD | Min | Max | Mean ± SD |
| 11-20 | 215 | 14 | 19.5 | 18 ±1.494 | 9 | 16 | 15 ±2.019 |
| 21-30 | 170 | 20.5 | 26 | 22 ±1.826 | 17 | 27 | 21 ±3.913 |
| Total | 385 | 14 | 26 | 19.5 ±2.925 | 9 | 27 | 16±4.870 |

**Table 2:** Length -Weight relationship of *Hemiramphus archipelagicus* of Karachi Coast.
N = Number, Min = Minimum, Max = Maximum, SD = Standard Deviation.

| Length groups (cm) | N | a | b | r | $W=aL^b$ |
|---|---|---|---|---|---|
| 11-20 | 215 | -1.023 | 2.87 | 0.940 | $W=-1.023L^{2.87}$ |
| 21-30 | 170 | -1.577 | 2.55 | 0.928 | $W=-1.577L^{2.55}$ |
| Total | 385 | -1.1088 | 2. 532 | 0.971 | $W=-1.108L^{2.532}$ |

**Table 3:** Condition Factor of *Hemiramphus archipelagicus* of Karachi Coast.
Min = Minimum, Max = Maximum, SD = Standard Deviation, SE = Standard error

| Length groups (cm) | Condition factor (K) Mean ± SD | Min | Max | SE |
|---|---|---|---|---|
| 11-20 | 0.257 ±0.031 | 0.215 | 0.327 | 0.004 |
| 21-30 | 0.197 ±0.016 | 0.153 | 0.197 | 0.0018 |
| Total | 0.2157 ±0.041 | 0.153 | 0.327 | 0.0014 |

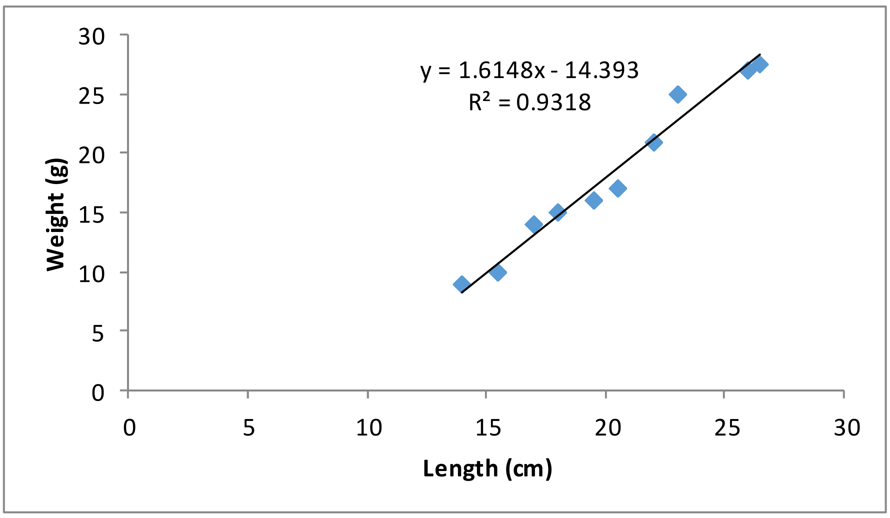


**Fig 1:** Scatter diagram showing length- weight relationship of *Hemiramphus archipelagicus.*

## 3. Results

A total of 385 samples of *Hemiramphus archipelagicus* were collected during the period from August 2010 to July 2011.

The highest catch of fish (215) was recorded in 11-20 cm and the lowest catch of fish (170) was recorded in 21-30 cm. The highest mean length (22 ± 1.826) was recorded in 21-30 cm. The lowest mean length (18 ± 1.494) was recorded in 11-20 cm. The highest mean weight (21± 3.913) was recorded in 21-30 cm and the lowest mean weight (15 ± 2.019) was recorded in 11-20 cm. (Table 1).

The results of the Length weight relationship are presented in (Table 2). The length weight relationship is useful for understanding the mathematical relationship between length and weight so that one may be converted into another. It is also useful to measure the condition, i.e., the variation from the expected weight for length of individual fish or group of individual as an indication of fatness, general well being and gonad development, etc [21]. Minimum and maximum observed total length (TL) of all the sample with 14 cm and 26 cm and the minimum and maximum observed weight (W) of all the sample with 9 g and 27 g. All length weight relationship (LWR) were highly significant ($P < 0.05$). The highest and lowest intercept (a) of the length weight relationship (LWR) were -1.577 and 1.023 in 21-30 cm and 11-20 cm, and the highest and lowest values of slope (b) were 2.87 and 2.55 in 11-20 cm and 21-30 cm. (Table 2).

Fishery biologists also stated that the 'a' and 'b' values differ not only in different species but also in the same species depending on sex, stage of maturity, food habits and so on [24, 25, 26]. It also showed that there was a strong connection between length-weight relationships.

The highest mean condition factor (0.257 ± 0.031) was recorded in samples of length of 11-20 cm. The lowest mean condition factor (0.197 ± 0.016) was recorded in 21-30 cm (Table 3). [27] described the seasonal variation of K in plaice of the south-eastern North Sea and found that the better the nutritional condition, the higher is K. The use of the length-weight Coefficient as the condition factor, also realized that differences in condition factor are directly proportional to differences in weight. K is a good indicator of fish well being in the natural habitat over time since K equation is based on body weight and length. The results showed that K varied mainly with size classes.

## 4. Discussion

Length weight relationship provides information on growth patterns and growth rates of animals. During their developing, fish are known to pass through stages in their life history, which are defined by different length- weight relationship. Length has an important function for the weight of fish [28]. The specific gravity of fish flesh is known to undergo changes, while [21] stated that the density of fish might be maintained in the surrounding water by means of the swim bladder. Hence the change in weight is due to changes in form, but not in specific gravity. Cube law is not confirmed for all fishes because growth causes for the change of their shape [29]. Allen KR [30] pointed out that the exponent coefficient (b) in the length-weight relationship of fishes is usually 3. Later, [31] pointed out that the 'b' value is very close to 3.0 but varies between 2.5 and 3.5. If the 'b' value for a fish is 3, the fish grows isometrically; if it is greater than 3, the fish exhibits positive allometry and if it is lower than 3 the fish exhibits negative allometry [32]. A historical review on length weight relationship and recommendations for users about length-weight relationships, condition factors and relative weight is provided by [25]. The transformed length fitted over weight gave linear growth, indicating the three dimensional growth structures of most fish species [33]. Values of the length exponent in the length-weight relationship being isometric implies that the fish species did not increase in weight faster than the cube of their total lengths. However, the weight of the rest species increased faster than the cube of their total lengths.

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