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Length-Weight Relationship and Condition Factor of Etroplus maculatus from Vellayani Lake and Veli Lake in Kerala

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Abstract: Etroplus maculatus, commonly known as Orange chromide, is an indigenous cichlid of the Peninsular India and Sri Lanka. In the present study, Length weight relationship (LWR) and condition factor were analysed in Etroplus maculatus, from Vellayani Lake and Veli Lake. The regression equation for LWR of the Vellayani Lake was estimated as Log W = -1.937 + 2.698 Log L, while those from Veli Lake as Log W= -2.133 + 2.811 Log L. Although, the 'b' value observed from Veli Lake (2.811) was higher than that from Vellayani Lake (2.698), they were statistically insignificant. The results indicated that populations of E. maculatus in both lakes followed a negative allometric growth pattern with 'b' values slightly below the isometric value of 3 but not significantly different from the cubic value. Similarly, the Condition Factor (K) was higher in Veli Lake specimens (1.7977) compared to Vellayani Lake (1.7481) indicating robustness or well-being of fishes. The results from this study also showed that fish in the lake are in good condition with condition factor value above 1.
Keywords: Length-weight relationship, Condition Factor, Etroplus maculatus, Growth Pattern, Cube Law

I. INTRODUCTION

Length weight relationship (LWR) of fishes are important in fisheries and fish biology because they allow the estimation of the average weight of the fish of a given length group by establishing a mathematical relation between them (Sarkar *et al*., 2008; Mir *et al*., 2012). The relationship between total length (L) and total weight (W) for nearly all species of fish is expressed by the equation: $W = aL^b$. LWR explain mathematically the correlation between fish length and weight and are useful for converting length observations into weight estimate to provide some measure of biomass.

In fish studies, the length of a fish is often more rapidly and easily measured than is its mass, therefore it is opportune to be able to determine mass where only the length is known. Like any other morphometric characters, the LWR can be used as a character for the differentiation of taxonomic units and the relationship changes with the various developmental events in life such as metamorphosis, growth and onset of maturity (Thomas et al., 2003). Fish can attain either isometric growth, negative allometric growth or positive allometric growth.

Isometric growth is associated with no change of body shape as an organism grows. Negative allometric growth implies the fish becomes more slender as it increase in weight while positive allometric growth implies the fish becomes relatively stouter or deeper-bodied as it increases in length (Riedel et al., 2007).

The exact relationship between length and weight differs among species of fish according to their inherited body shape, and within a species according to the condition (robustness) of individual fish. Condition sometimes reflects food availability and growth within the week period of sampling. The condition factor which show the degree of well-being of the fish in their habitat is expressed by 'coefficient of condition' also known as length – weight factor. It is therefore an index reflecting interactions between biotic and abiotic factors such as degree of fitness, gonad development and the suitability of the environment with regard to the feeding condition (Mac Gregoer, 1959).

When condition factor value is higher it means that the fish has attained a better condition. The condition factor of fish can be affected by a number of factors such as stress, sex, season, availability of feeds and other water quality parameters (Khallaf et al., 2003). It is an important concept in fisheries management and can be used to assess the health and potential of any fishery to support the fishing pressure. This simple approach and interpretation can therefore aid in development of intervention measures which can easily be implemented by fishery managers especially with respect to maintaining a healthy fish population through controlling of the fishing effort (Otieno et al., 2014). The main focus of this paper is to assess the length-weight relationship and condition factor of Etroplus maculatus from Vellayani Lake and Veli Lake.

II. MATERIALS AND METHODS

A. Sampling Area

The fish samples were obtained from two different locations, Veli Lake and Vellayani Lake from Thiruvananthapuram District. The Veli Lake is a small and shallow lake in the southwest coast of India which is located in 8°31'39'N latitude and 76°54'30'E longitude (area=1 km^2 ; depth= <1m), which remain separated from the Arabian sea by a sand bar during most months of the year, except during monsoon season (Fig. 1). Similarly *E. maculatus* were collected from Vellayani Lake or Vellayani Kayal as known in local language, the largest fresh water lake in Thiruvananthapuram district of Kerala which is located in 8°24'N latitude and 76°59'E longitude (Fig. 2). The length of the lake is about 3.15 km and maximum width is about 1000 m; depth of the lake varies from 2 to 6 m. It has a water spread area of 450 ha. The depth of the lake varies from 2 to 6 m. The northwestern part of the lake is converted to a temporary reservoir for irrigation purpose and this lake act as a major source of drinking water supplies (Abhijna and Bijukumar, 2017). The specimens from both Lakes were collected during February 2018.

B. Sampling of Fish

Total 50 fish samples each were collected randomly from two sampling stations, Vellayani Lake and Veli Lake. Fish were mopped on a filter paper before they were weighed to remove excess water from their body in order to ensure accuracy. Total length (cm) of each fish was taken from the tip of the snout (mouth closed) to the extended tip of the caudal fin using a measuring board. Body weight was measured to the nearest gram using electronic balance. Parameters of the length-weight relationship of identified fish species were estimated using the equation Le Cren (1951) formula or its logarithmic form.

For calculating the length-weight relationship method suggested by (LeCren, 1951) was followed. The length – weight relationship can be expressed as:

$W = a L^b$

Where W and L are weight (g) and length (mm) of the fish respectively and 'a' and 'b' are two constants (initial growth index and regression constants respectively). The values of constant a and b are determined empirically from data, as the coefficient of condition (Richer, 1975).

Logarithmically the above equation becomes straight line of the formula:

$\text{Log } W = \log a + b \log L$,

The constants 'a' represents the point at which the regression line intercepts the y- axis and 'b' the slope of the regression line were estimated by the method of least square (Snedecor and Cochran, 1967).

Condition factor K, a measure of the well-being or plumpness of a fish, was calculated according to the equation presented in (Carlander, 1977):

$K= W \times 10^N / L3$.

Where W is the weight of the fish in grams and L is the total length of the fish in millimeters. The number 10^N is a scaling factor when metric units are used (i.e., grams and millimeters) and is used to bring the value of K near unity.

Fig. 1: Etroplus maculatus

C. Statistical Analysis

Statistical analysis Length-Weight relationship was calculated according to the method mentioned by Le Cren (1951). Linear relationship between the logarithm length and logarithm weight was found from the examination of scatter diagram. All data were calculated in MS-Excel 2010 and Graphpad Software (Graphpad Instat-3 San Diego) used for analysing the data.

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III. RESULTS

The Length Weight Relationship (LWR) of Etroplus maculatus was examined by simple linear regression analysis. Variations in the length – weight relationship and mean condition factor (represented by K) of the individual fish living in the two locations were found. In the present study, the minimum and maximum recorded range of TL varies from 4.9cm - 9.5 cm in Vellayani Lake and 5.4-8.5 in Veli Lake (Table 1). TW range varies from 11gm-68.25gm in Vellayani Lake and 12.5gm-45.2gm in Veli Lake (Table 1). Average value of total length and weight of fishes in Vellayani and Veli Lake was 6.894, 28.691 and 6.71, 25.574 respectively (Table.1). The slope (b) of the length – weight relationship was conducted to perform comparisons of the condition of fish between the different sampling sites. The slope (b) of the length – weight relationship is 2.698 (Fig. 4) and the mean condition factor 1.7481 (Fig.6) in Vellayani Lake specimens and the slopes (b) value is 2.811 (Fig.5) and the mean condition factor value is 1.7977 in Veli Lake (Fig.6).

Based on the calculation, the relationship could be expressed as

Log W = -1.937 + 2.698 Log L

And Log W= -2.133 + 2.811 Log L

Fig. 2: Measurement of weight during study of Etroplus maculatus

Table I: Size Variation Of Etroplus Maculatus In Vellayani Lake And Veli Lake

Sampling Station	Total Length (Cm)		Total Weight (G)		Average Size (Mean ±SD)		No. of Samples
	Min	Max	Min	Max	Total Length	Total Weight	
Vellayani Lake	4.9	9.5	11	68.25	6.894±1.302	28.691±15.553	50
Veli Lake	5.4	8.5	12.5	45.20	6.71±0.642	25.574±6.557	50

Table Ii: Length-Weight Relationships Of Etroplus Maculatus In Vellayani Lake And Veli Lake

Sampling Station	Mean ±SD		a	b	R^2	K (Mean ±SD)	GP
	Log Length	Log Weight					
Vellayani Lake	1.91339±0.1874	3.22650±0.5105	-1.937	2.698	0.981	1.7481±0.3808	NA
Veli Lake	1.89909±0.0962	3.20537±0.2821	-2.133	2.811	0.919	1.7977±0.2146	NA

SD=Standard Deviation, a = intercept of regression line, b = Slop of regression line, R^2 = regression coefficient, K = Condition Factor,

GP = Growth Pattern, NA = Negative Allometric.

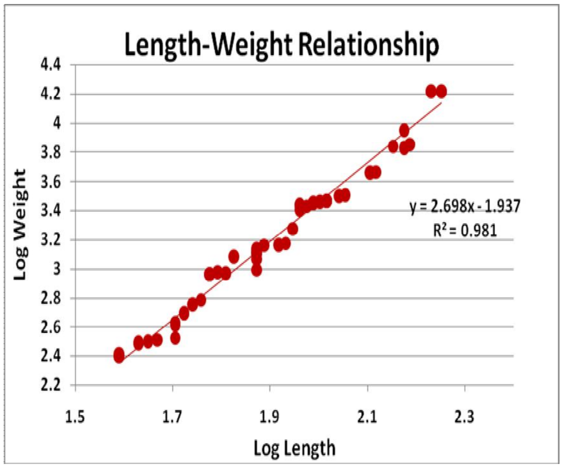

Figure 4: Length-Weight Relationship of Etroplus maculatus from Vellayani Lake

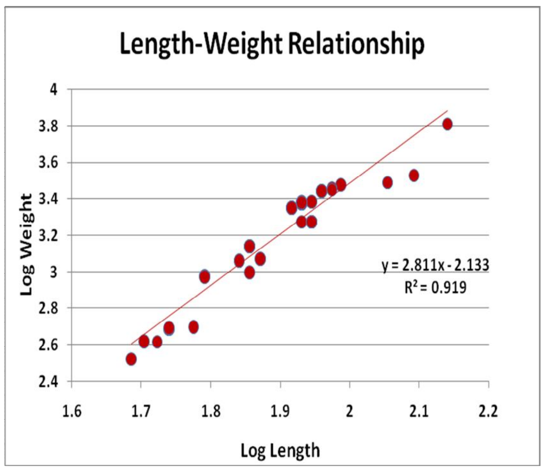

Figure 5: Length-Weight Relationship of Etroplus maculatus from Veli Lake

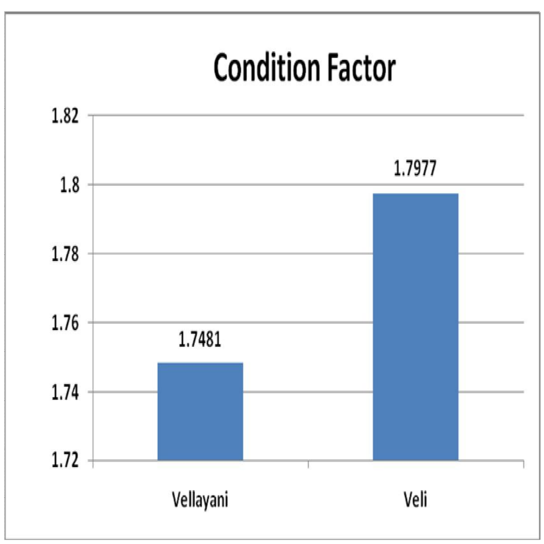

Figure 6: Condition Factor (K) of Etroplus maculatus from Vellayani Lake and Veli Lake

The 'b' value of E. Maculatus in both Vellayani and Veli Lake is slightly below the isometric value of 3 but not significantly different from the cubic value. However, the data showed that the species grow negative allometrically in both Lake. Similarly, the condition factor of E. Maculatus in Vellayani Lake (1.7481) showed a lower value from Veli Lake (1.7977) specimens. The regression coefficient (R^2) values, calculated for the total LWRs, varied from 0.919 in Veli Lake to 0.981 in Vellayani Lake.

IV. DISCUSSION

A. Length- Weight Relationship

The length weight relationship is the most important aspect in biological studies of fishes. Exponent of the arithmetic form and the slope of the regression line in the logarithmic form 'b' are the most important parameters in a LWR. The 'b' value less than 3 shows that fish become lighter (negative allometric) for a particular length. The value of the regression co-efficient usually lies between 2.5 and 3.0 only and ideal fish maintains the shape i.e. b = 3. If 'b = 3', then small specimens in the samples under consideration have the same form and condition as large specimens, then the growth in fish is isometric. If 'b > 3', then large specimens have increased in height or width more than in length, either as the result of a notable ontogenetic change in body shape with size, which is rare, or because most large specimens in the sample were thicker than small specimens, which is common. Conversely, if 'b < 3', then large specimens have changed their body shape to become more elongated or small specimens were in better nutritional condition at the time of sampling (Froese, 2006).

According to Le Cren (1951) fishes may not retain the same shape or body outline throughout their lifespan and the specific gravity of the tissue also do not remain constant. The value of b gives information on the kind of growth of fish. In the present study, the value of exponent 'b' was found to be 2.698 in Vellayani Lake and 2.811 in Veli Lake specimens. According to the theory of 'Cube law', if the 'b' value in length weight relationship is reported as 3, then the growth in fish is isometric. When b>3, it shows a positive allometric growth which is defined hyperallometry. In this present study, the 'b' value of both Lake specimens indicate negative allometric growth (b<3). So, it can be said that the fish does not follow the cube law (i.e. b=3). Several authors (Kurup et al., 2002, Kharat et al., 2008, Froese, 2006, Araneda et al., 2008), have observed such departures of the cubes law among a variety of fishes. A similar variation for cubes law was also reported for E.maculatus in Kayamkulam Lake (Sajeevan, 2014). The negative allometry in the length-weight relationship of fish in the whole lake was an indication that the population of the species in these zones had heterogeneous groups with body weights varying differently with the cube of total length (Otieno et al., 2014). While studying the length-weight relationship of over 23 species of small pelagic fishes of the Brazilian Exclusive Economic Zone, Bernades et al. (2000) observed that the b values vary considerably between 2.72 and 3.53. Jones (1976) indicated this may be considered only as either seasonal or regional fluctuations or probably due to environmental conditions. It is also inferred that higher b values indicates relatively productive environmental conditions (Gopakumar et al., 1991) and if so LWR data appear to reflect the poor growing condition of the fish in these waters.

Many factors could contribute to the differences of growth of fish such as difference of habitat, fish activities, food habits and seasonal growth rates (Hossain et al., 2009). Other factors such as temperature, trophic level and food availability in the community were also important. The present results also revealed that length and weight measurements of the fish are related to each other. The regression equation of E. maculatus, Log W = -1.937 + 2.698 Log L, and Log W= -2.133 + 2.811 Log L respectively for Vellayani and Veli Lake and further $W = aL^b$ was found to be fit with length-weight data. Differences in 'b' values and its variations from the ideal '3' can also arise due to variations in habitat, gonadal maturity and preservation techniques among others (Tesch 1971; Wooton, 1996). Previous studies also indicate that LWR is also subjected to evolutionary selection (Kharat *et al.*, 2008).

B. Condition Factor

The condition factor, *K*, was used to assess the degree of well-being of E. maculatus in the study area which provides information on the environmental quality and suitability (polluted or non-polluted of the ecosystem, physical and biological circumstances and fluctuations by interaction among feeding conditions, parasitic infections and physiological factors (Le Cren, 1951). Wootton (1996) reported that fish with higher K values (> 1) are in a better condition than fish with lower K values (< 1). From this study, the condition factor value was found to be 1.7481 for Vellayani Lake and 1.7977 for Veli Lake indicates fishes in both lakes showed good condition with values above 1. This could be due to abundance of food within the lake as this has been shown to improve the condition of fish further indicates the changes in food reserves and therefore an indicator of the general fish condition. High K values have been attributed to food or prey availability and abundance and feeding intensity of the fish, good environmental conditions such as high dissolved oxygen, moderate temperature, low or absence of predators, low fishing pressure, genetic and immune and self-regulatory systems (Lagler et al., 1977; Idowu 2007; Guidelli et al., 2011; Abdul et al., 2016). Moreover, body condition provides an alternative to the expensive *in vitro* proximate analyses of tissues (Sutton *et al.*, 2000). Therefore, information on condition factor can be vital to culture system management because they provide the producer with information of the specific condition under which organisms are developing (Araneda *et al.*, 2008). This expresses the degree of wellbeing, robustness, fatness in numerical terms. Further it is suggested that condition factor is strongly influenced by both biotic and abiotic environmental conditions and can therefore be used as an index to assess the status of the aquatic ecosystem in which fish live (Anene, 2005).

V. CONCLUSION

The results of the present study indicate that populations of Etroplus maculatus in vellayani and Veli Lake follow a negative allometric like growth pattern with ‘b<3’ based on cubic law. Similarly, the condition factor value indicates fishes in both lakes showed good condition with values above 1. The results of the present investigation on length-weight relationships and condition factor of Etroplus maculatus suggests that both Vellayani Lake and Veli Lake habitat are conducible for the optimum growth of the fish. The present study thus provides baseline information on the growth status of E. maculatus that will be useful for researchers in future study.

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REFERENCES

[1] Abdul, W.O., Omoniyi, I.T., Adekoya, E.O., Adeosun, F.I., Odulate, O.O., Idowu, A.A., Olajide, A.E., Olowe, O.S. (2016). Length-weight relationship and condition factor of some commercial fish species in Ogun State Coastal Estuary, Nigeria. Ife. J. Agric. 28(1):1–9.

[2] Abhijna, U.G., Biju Kumar, A. (2017). Development and evaluation of fish index of biotic integrity (F-IBI) to assess biological integrity of a tropical lake Veli-Akkulam, South India, Int. J Fisheries Aqua. Studies. 5(3): 153-164.

[3] Anene, A. (2005). Condition factor of four Cichlid species of a man-made lake in Omo state, Southern Nigeria, Tur. J. Fish. Aqua. Sci. 5: 43-47.

[4] Araneda, M., Perez, E.P., Gasca, L.E. (2008). White shrimp Penaeus vannamei culture in freshwater at three densities: condition state based on length and weight, Aquacult. 283: 13–18.

[5] Bernardes, R.A., Rossi-Wongtschowski, C.L. (2000). Length-Weight Relationship of Small Pelagic Fish Species of the Southeast and South Brazilian Exclusive Economic Zone Naga, The ICLARM 23(4).

[6] Carlander, K.D. (1977). Handbook of freshwater fishery biology, volume 2. The Iowa State University Press, Ames, Iowa.

[7] Froese, R. (2006). Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations, J. Appli. Ichthyol. 22:241–253.

[8] Gopakumar, G., Gopalakrishna Pillai, N., Omana, T.A. (1991). The fishery characteristics and biology of mackerel at Vizhinjam, J. Mar. Biol. Ass. India, 33 (1-2): 107-114.

[9] Guidelli, G., Tavechio, W.L.G., Takemoto, R.M., Pavanelli, G.C. (2011). Relative condition factor and parasitism in anostomid fishes from the floodplain of the Upper Parana River, Brazil. Vet Parasitol. 177:145–51.

[10] Hossain, M. Y., Jasmine, S., Ibrahim, A. H. M., Ahmed, Z. F., Rahman, M. M., Ohtomi, J., 2009. Length–weight and length– length relationships of 10 small fish species from the Ganges, Bangladesh. J. Appl. Ichthyol. 25:117–119.

[11] Idowu, E.O. (2007). Aspects of the biology of Hepsetus odoe in Ado-Ekiti Reservoir Ekiti, Nigeria Ph.D thesis, University of Ibadan, Ibadan.

[12] Jones, R. (1976). Growth of fishes, P. 251- 279. In D.H. Cushing and J.J. Walsh (eds.). The ecology of the seas. Blackwell Scientific Publications, Oxford. 467 p.

[13] Khallaf, E. A., Galal, M., Authman, M. (2003). The Biology of Oreochromis niloticus in a polluted canal, Ecotoxicol, 12: 405-416.

[14] Kharat, S.S., Khillare, Y.K., Dahanukar, N. (2008). Allometric scaling in growth and reproduction of a freshwater loach Nemacheilus mooreh (Sykes, 1839), Elect. J. Ichthyol. 4(1): 8–17.

[15] Kurup, B.M., Radhakrishnan, K.V., Euphrasia, C.J. (2002). Length weight relationship of some of the endangered and critically endangered freshwater fishes of Kerala part of the Western Ghats. In: Life History Traits of Freshwater Fish Population for its Utilization In Conservation. National Bureau of Fish Genetic Resources (NBGFR)-National Agricultural Technology Program (NATP) Publication No 4. Lucknow, India, AA2 1-4.

[16] Lagler, K.F., Bardachi, J.E., Miller, R.R., Passino, R. (1977). Ichthyology. New York: John Wesley and Sons.

[17] Le-Cren, E.D. (1951). The length-weight relationship and season cycle in gonad weight and condition in Perch (Perca fluviatilis), J. Ani. Ecol. 20:179–219.

[18] Mac Gregoer, J. S. (1959). Relation between fish condition and population size in the sardine (Sardinops cacrulea). U.S. Fishery Wild Service, Fish Bulletin, 60:215-230.

[19] Mir, J.I., Sarkar, U.K., Dwivedi, A.K., Gusain, O.P., Pal, A., Jena, J.K. (2012). Pattern of intrabasin variation in condition factor, relative condition factor and form factor of an Indian Major Carp, Labeo rohita (Hamilton-Buchanan, 1822) in the Ganges Basin, India. Europ. J. Biol.Sci. 4:126-135.

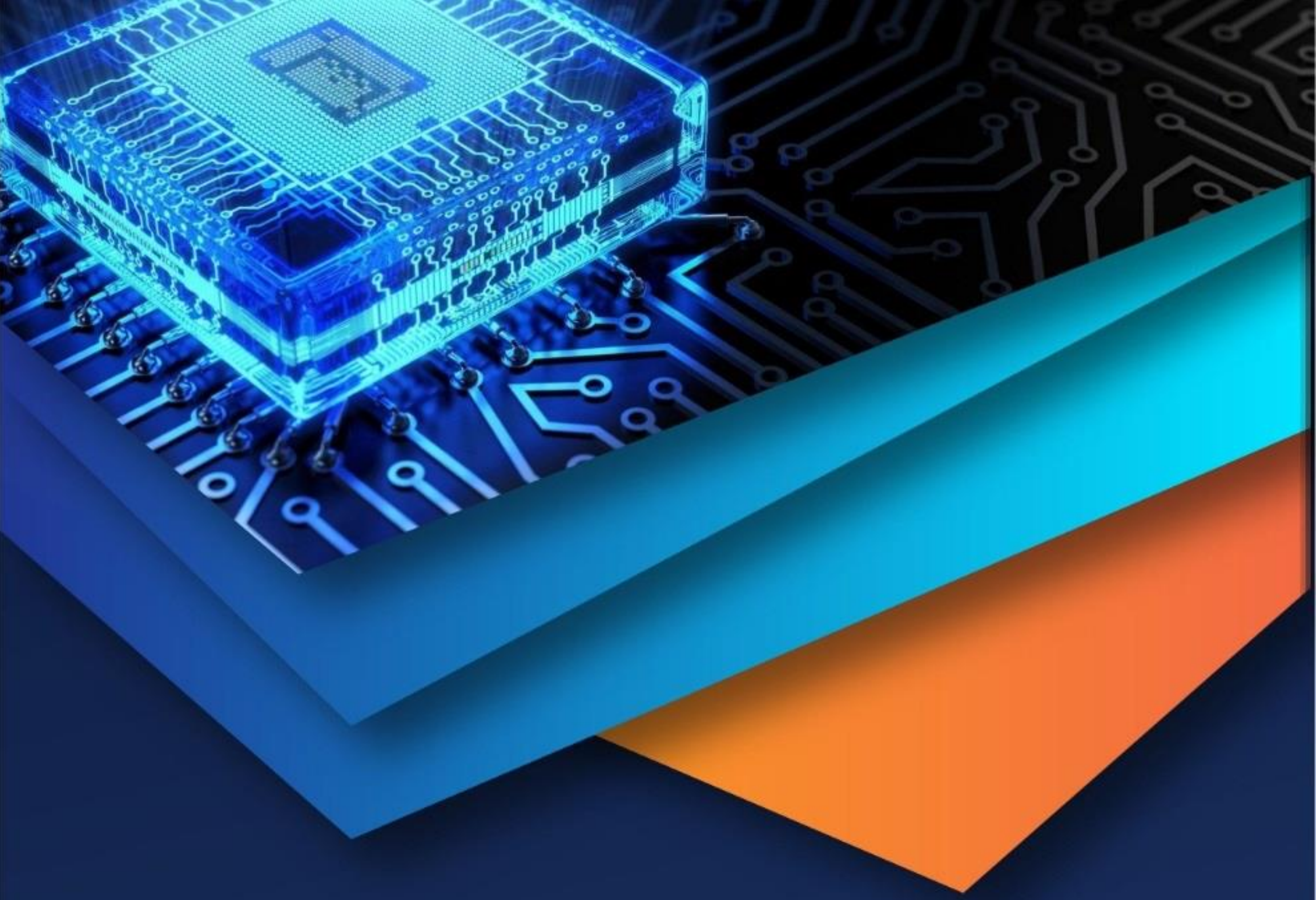
[20] Otieno, O.N., Kitaka, N., Njiru, J.M. (2014). Length-weight relationship, condition factor, length at first maturity and sex ratio of Nile tilapia, Oreochromis niloticus in Lake Naivasha, Kenya IJFAS , 2(2): 67-72.

[21] Richer, W.E. (1975). Computational interpretation of biological statistics of fish population, J. Fish. Res.Bd.Can.Bull. 191:382.

[22] Riedel, R., Caskey, L.M., Hurlbert, S.H. (2007). Length-weight relations and growth rates of dominant fishes of the Salton Sea: implications for predation by fish-eating birds, Lake and Reservoir Management. 23:528-535.

[23] Sajeevan, S. (2014). Growth status of Orange Chromide, Etroplus maculatus (Bloch) in Kayamkulam Lake, South Kerala (India), Int. J Environ. Sci. 4(5):626-632.

[24] Sarkar, U.K., Deepak, P.K. Negi, R.S. (2008). Length-weight relationship of clown knifefish Chitala chitala (Hamilton 1822) from the Ganga basin, India, J. Appl. Ichthyol., 25, 232-233.
[25] Snedecor, G.W. and Cochran, W.G. (1967). Statistical Methods. Oxford and IBH Publishing Co., New Delhi.
[26] Sutton, S.G., Bult, T.P., Haedrich, R.L. (2000). Relationships among fat weight, body weight, water weight and condition factors in wild Atlantic salmon parr, T. Am. Fish Soc. 129:527–538.
[27] Tesch, F.W. (1971). Age and growth, pp. 98–130. In: Ricker, W.E. (ed.). Methods for Assessment of Fish Production in Fresh Waters. Blackwell Scientific Publications, Oxford.
[28] Thomas, J.S., Venus, S., Kurup, B.M. (2003). Length-weight relationship of some deep-sea fish inhabiting continental slope beyond 250 m depth along West coast of India Naga, World Fish Center Quart. 26:17-21.
[29] Wooton, R.J. (1996). Ecology of Teleost Fishes. Chapman and Hall, London, 404pp.



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