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Description of the growth of Nile tilapia (*Linnaeus*, 1758) *Oreochromis niloticus* in the Tigris River south of Baghdad

Raaed Sami Attee[1*], Abd Al Karim jassem Abu AlHeni[2], Salam Zidane Khalifa[1]

University of Diyala, College of Agriculture[1], Ministry of Science and Technology[2] Department : Animal Production, Iraq

Abstract : The present study was carried out in the Tigris river south of Baghdad for the period from July 2016 to April 2017. During which 169 fish were harvested. *Oreochromis niloticus* Nile tilapia ranged from 68 to 274 mm in length and total weights from 6.6 to 378.79 g . Water temperatures ranged between 31 and 8.5c . With values of pH ranges from 7.2 and 7.8 . The values of dissolved oxygen ranged from $11.5g^{-1}$ to $7.1g^{-1}$ and salinity values were recorded from $0.82g^{-1}$ to $0.44g^{-1}$. The physic-chemical properties were suitable for the growth and living of Nile tilapia in the Tigris River. The relationship between total length and weight was found to be allometric 2.039. The growth criteria values were k 0.108 and t_o 0.27. Maximum expected length L_∞ of fish reaches 293.68 mm. The average condition factor was 2.67. Six age groups were identified and recorded the highest increase in length during the first year of the fish's life and by 34.10%.
Keywords: Nile tilapia. Age and growth. Tigris River, Condation factor.

Introduction

Tilapia of freshwater cichlid fish introduced in Africa are many tropical subtropical and temperate regions of the world during the second half of the twentieth century (Pillay, 1990). They belong to the Cichlidae family and to the rank of Perciformes and include three major species: *Tilapia*, *Sarotherodon*, *Oreochromis* (Yakubu,2011). Each containing several species, including Nile tilapia, *Oreochromis niloticus,* tilapia, *Oreochromis aureus* , and *Tilapia zillii* (EL_shazly, 1993). Has spread recently in Iraqi waters in an unknown way and may have moved from the riparian countries with Iraq such as Syria, Iran and Turkey. Two species were recorded in the southern part of the general estuary in Basra, namely *T. zillii* and *O . aureus* (Mutlaq and Al-Faisal, 2009). The type *T. zillii* was recorded in Hor Al-dlameg (AL-Zaidy, 2013) and *O.niloticus* in the Shatt Al-Arab south of Iraq (Mutlaq and Al-Faisal, 2014). A comparative study was conducted between two types of tilapia in the Mesopotamian Euphrates River, *T. Zillii* and *Oreochromis aureus* (Abu Al-Heni *et .al*, 2015).

In recent years, *Tilapia* production has increased significantly, commercially, and globally, particularly in Africa (Durr and Gonzaleze, 2002). The platypus family has invaded rivers and lakes in most parts of the world and has the ability to withstand high temperatures, salinity and changes in dissolved oxygen, making it adaptable to changing environmental conditions, allowing it to exist and spread beyond its original habitat

(Martin *et al*., 2010). It is a tropical fish and does not live in water, some of them can live in cold water to be at least 8c, plant nutrition and a section of them prefer the herds (Cleberd & Alesandra, 2005)

O. niloticus is one of the ten most important species in the world (Picker and Grifths, 2011) introduced into more than 90 countries around the world (Fitzsimmons, 2001). It is one of the most important species of fish, which can reduce the gap increase in demand for protein (Romanol *et al*, 2013). Its production worldwide increased from 1,099,268 tons in 1999 to approximately 3.500.000 tons in 2010, but production is still low to meet demand (FAO, 2012). The current study aims to describe the growth and identify the ages prevailing in the community and find the maximum length expected to reach the fish and determine the coefficient of the situation In the Tigris River, south of Baghdad. The study is the first of its kind in the Tigris River south of Baghdad and there have been no previous studies of Nile tilapia at that site.

Materials and Methods.

Description of Study Area

The Tigris River is one of the main rivers in Iraq (Whitton, 1975). Its total length is 1,900 km, 20% of it inside the Turkish territory, 78% of it in Iraqi territory, and only 2% located along the north-east corner of Syria and meet the Euphrates River in Qurna to form the Shatt al-Arab (VanDerLeeden, 1975). A number of dams have been installed to absorb the flood waters, such as the Mosul dam, Samarra and Kut Barrier. There are also electric power stations, as well as for agricultural purposes, and the width of the river and its depth depend on seasonal water discharge (Kassim, 1997) Figure (1) . The fish samples were collected in 169 fish with lengths of kidney length (68-274 mm) and total weights of (6.6-378.79g). By means of the means of fishing used such as gill nets (26 m) and diameter of the openings (30 × 40) as well as nets grating and erection. With one sample per month for the period from July 2016 to April 2017, but it was not possible to obtain during the month of January because of the low temperature to 8.5c. killed fish immediately after being hit by beating on the head and the fish caught in cork containers with ice and grated frozen

Fish were classified according to FAO (2006) and FAO (2007). The number of gill rickers on the first arch ranged from 27 to 33 cm, 16-17 in the dorsal fin and 11-15 in fine. Nile tilapia also had a black point on the gilt cover of the back.

Laboratory work .

Both the total length and the standard length were measured to the nearest millimeter using an incorporated ruler and the total weight to the nearest 0.1 g using a sensitive electrical balance type Sartorius . The scale samples were taken from the left side of the area under the dorsal fin above the lateral line. Peel the scale in a glass dish containing KOH solution (2%) for 24 hours. then wash with water and bind with a cloth and put 6 to 8 flakes between two glass slides and fastened with a transparent adhesive tape On which the fish information is installed, use a Projectina microscope with an 2x magnification force to read the age of the fish. A paper tape was placed from the beginning on the center of the veneer and was indicated by the location of each annual ring and the edge of the veneer. The exponential relationship between total length (L) and weight (gm) was found by the following equation.

$W = a L^b$ (Lecren, 1951).

W represents weight ; L total length b, a. The value b was statistically tested to determine its deviation from the fish value of 3.0 (Ricker, 1975). The relationship between the total length of the fish and the radius of the crust was calculated using the linear regression equation (Hile, 1970) TL = a + bS, where S is the radius of the cortex, a is the value of the intersection with the y-axis, and b is the simple regression coefficient. The method of back calculations was applied to estimate fish lengths for fish ages in previous years (Bagenal, Tesch, 1978; Carlander, 1982). Ln = a + Sn / S (L - a) ¸ Ln The length of the fish at the annual ring n, a the length at which the crust first appears, Sn the radius of the crust at the ring n, S the radius of the scale, L the length of the fish observed at the catch. For the purpose of explaining growth and describing the relationship between total length or weight with age. The Von Bertalanffy equation (1938) was used (Tharwat and El-Dawi, 1997). $L_t = L [1\_e^{-k (t -to)}]$ ¸ Lt Length Lt Length at time t, L_∞ Maximum expected length of fish, t Age in years, K Growth constant, to Life time when the length of the fish is zero to obtain the maximum expected length of fish, use the following

equation. L_∞ = Lmax \ 0.95 cm According to FAO (1998), L_∞ represents the maximum length expected to reach the fish, Lmax maximum length obtained at catch. The condition factor was calculated in the following manner as reported in Holopainen and Oikari (1992). C.F = W / L^3 X100

W weight, L^3 total length

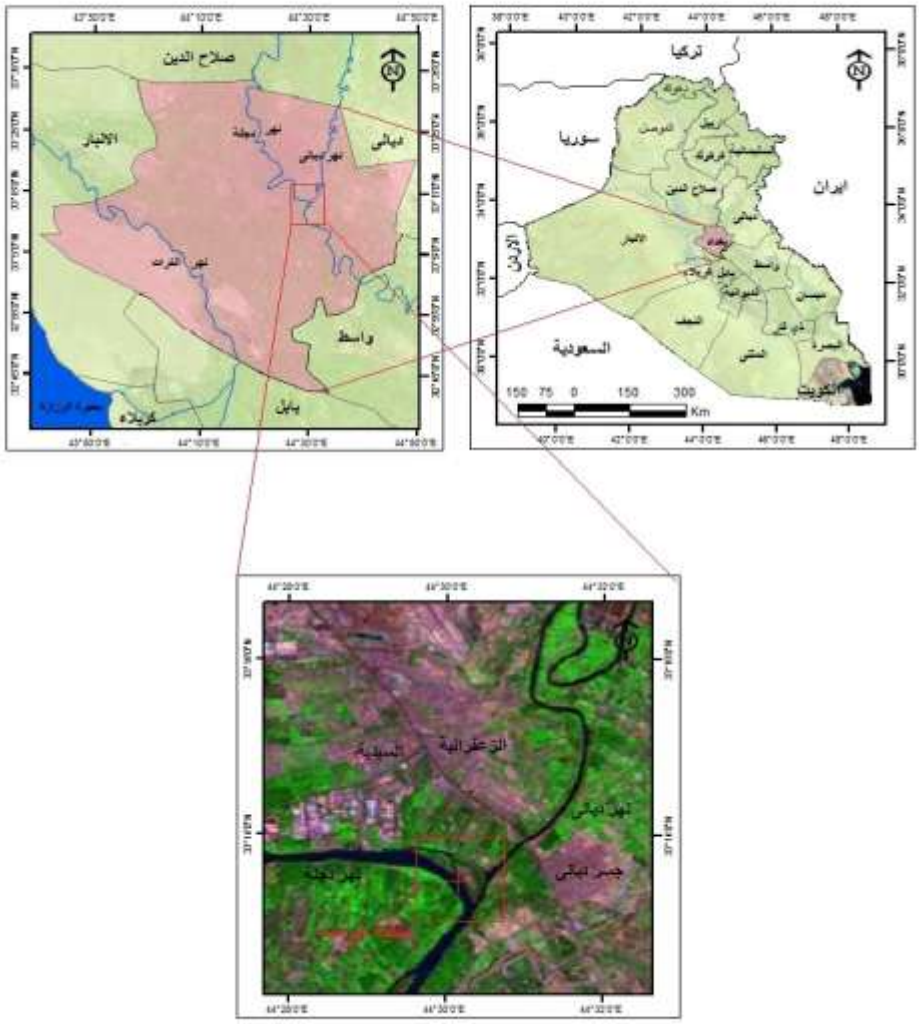

Figure 1: location of the study

Results and Discussion

Water temperature

The present study revealed a clear monthly differences in water temperatures. These differences were due to the large variation in temperature between summer and winter. The highest water temperature was recorded at 31c during July 2016 and the lowest temperature recorded was 8.5 in January 2017 as in Table (1).

The nature of the climate in Iraq is characterized by large variations in temperature in different months of the year. The temperature showed a range of changes during the study period. Indicating the effect of water temperature on air temperature due to their daily fluctuation (Ganemi,2003). This is what Charo-karisa (2005) points out that tilapia has the ability to adapt to low temperatures (up to 13.6c).

Hydrogen Ion Concentration .

The pH represents the effect of free hydrogen ion that is not associated with carbonates or other bases. The pH ranged between 7.2 and 7.8 during the months of the year, recording the highest value of 7.8 during the month of February and the value of 7 during the month of August as in table (1). This is consistent with studies on the Tigris River, such as Tamimi (2004). who have recrded values between7.56 - 8.40 and AL- Lami (2002) between 8.2-6.8. This is due to the presence of carbon ion in nature (Linde 1979). The decrease in pH values is due to the degradation of some aquatic plants, phytoplankton and organic matter, resulting in the production of carbon dioxide (Zubaidi 1985). The increase is due to the density of aquatic plants and phytoplankton, which stimulates photosynthesis. Carbon and then increased PH (Sabri *et al*. 1989). Amongst (Ross2000) the best growth rates for tilapia fish occur at pH between 7-9.

Salinity

Salinity values ranged between the highest value of 0.82 g^{-1} in January and is it lowest value of 0.44 g^{-1} in April as in table (1). Salinity refers to the concentration of soluble salts in water, including positive ions (potassium, calcium, magnesium and sodium) and negative ions (carbonate, bicarbonate, sulfur and chloride). Salinity in the aquatic environment is important for aquatic plants and animals living in a specific salinity level (Friedl *et al*, 1998).

Dissolved oxygen

The highest dissolved oxygen value was 11.5 during the month of January and is it lowest value of 7.1 August as in table (1). during the month of August and the highest values of dissolved oxygen recorded during the winter months due to low temperatures (Macan,1980) because the temperature controls the amount of dissolved oxygen. The higher the temperature give less dissolved oxygen . Because the melting of gases is inversely proportional to the water temperatures (Sabri *et al*. 1989), there was a decrease in the dissolved oxygen values during the month of August due to the high temperature of the water, which in turn leads to the melting of dissolved oxygen, thus reducing the efficiency of photosynthesis and increasing the process of photosynthesis Of the dissolved oxygen (Saadi, 2006). The results of the study agreed with the results of the study of (Saadi *et al*.,1999) . Who found oxygen concentration 6.6 - 13.5g^{-1}. Boyd (2004) reported that oxygen concentration is not a limiting factor for tilapia because it bears low levels of 3-4 g^{-1}.

Table (1) : Some characteristics of the water of the Tigris River south of Baghdad for months collection of samples

Property / Month	Temperature C°	Dissolved oxygen g^{-1}	Salinity g^{-1}	pH
July	31	7.6	0.56	7.3
August	30.5	7.1	0.54	7.2
September	25.5	7.4	0.61	7.4
October	24.5	9.5	0.53	7.5
November	16.5	7.7	0.62	7.4
December	9.9	10.1	0.73	7.7
January	8.5	11.5	0.82	7.7
February	11.5	10.9	0.68	7.8
March	15.8	7.2	0.52	7.5
April	21	7.1	0.44	7.6
Average	19.47	8.56	0.60	7.49

Back - calculation.

The total length range from 68 to 274 mm and total weights from 6.6 to 378.79 g. The Nile tilapia in the Tigris River reached age of six. The largest increase in length was recorded in the first year of the fish age, reaching 81.02% and 34% of the total increase (Table 2). It was noted that the annual increases fluctuated did not take the status of continuous decline and thus are not subject to the Lee phenomenon of me and may be attributed to the types of nets used in fishing. The results of this study were consistent with those of Al-Mutlaq and Al-Faisal (2014). The largest length recorded was 292 mm and 500 g in Shatt al-Arab. The Food and Agriculture Organization (2012) indicated that Nile tilapia grows to 62 cm and weight more than 3 kg with age upto 9 years. Differences in the length and age of fish may be due to the nature of the lake and in a tropical region as well as the environment suitable for the growth of individuals so that the fish can reach the same length at a lower age in the dark environment; and also affect the method of fishing and nets in fish size in any environment.

Table (2): Average total calculated length, annual rate of increase and percentage of different age groups of Nile tilapia in Tigris

Age group	Average observed overall length (mm)	Average total length calculated at the ring						Annual increase (mm)	the increase %
		1	2	3	4	5	6		
1$^+$	95.29	76.10						81.02	34.12
2$^+$	127.09	74.80	121.10					37.40	15.75
3$^+$	160.12	83.69	111.78	134.20				28.85	12.15
4$^+$	187.73	87.15	124.77	165.52	169.50			35.38	14.09
5$^+$	202	81.60	127.17	167.10	238.40	176.60		14.05	5.91
6$^+$	239.50	82.78	107.30	122.58	140.00	216.80	237.40	40.70	17.14
Average		81.02	118.42	147.27	182.65	196.70	237.40		99.16

Table (2) and Figure (2) indicate a fluctuation between the rise and fall in the annual rate of increase with age. The largest increase in length was recorded in the first year of life at 81.02 mm and by 34.10% of the total increase and 37.4 mm by 15.07 % ، 28.8 mm by 12.15% ، 35.38 mm by 14.09% ، 14.05 mm by 5.91% ، 40.7 mm by 17.14% for the years of successive ، this means that Nile tilapia fish in the Tigris River is not subject to the phenomenon of Lee to suggest that the annual increase length decreases with Aging. The annual increases in the total length of the fish are irregular and are consistent with the results shown in Table (2).

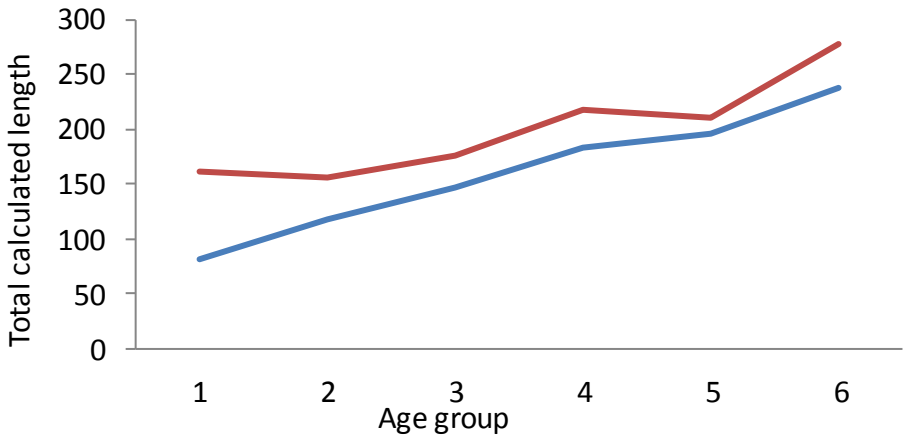

Figure 2: Average total calculated length and annual increase in length (mm) during different age groups of Nile tilapia in Tigris

Length–weight relationship.

The relationship between total length and weight was the equation of the curve line with the equation $W = aL^b$ and the growth relationship was allometric since the mean value was 2.039. This means that the growth is in favor of the increase in length at the expense of weight (Fig. 3). The results of the study differed with Piya and Kosal (2014), where b was shown as equal to 3.026. Murphy et al. (1991) note that the difference in the standard growth of different tilapia is mainly due to feeding and fish density in water .

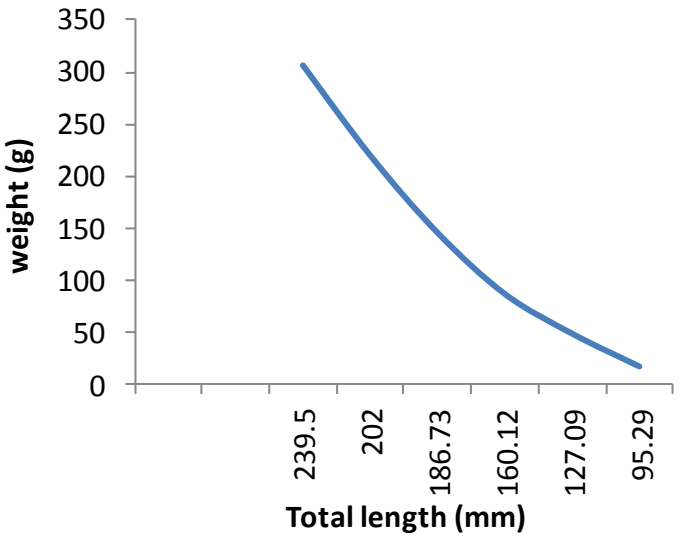

Figure 3: The exponential relationship between the total length and total weight of Nile tilapia in the Tigris River during the study period

The correlation between the total length and the diameter of the scale of the Nile tilapia was estimated in the Tigris River represented by the following equation $TL=^{-}5.66+0.35^{x}$ the -5.66 total length of the crust in which the crusts first appeared on the fish's body was 4. Note that the increase in height is rapid in the first years of life and decreases annual increases in the growth rings in fish scales with age. The results of the study were different with Hatem (2014) where TL = 2.3174S + 1.2082 and the correlation coefficient value was equal to $R^2 = 0.9704$. Ujjania (1997) pointed to a very large coefficient of correlation between the weight of the fish and the radius 0.266 - 0.278 and between the total length and the radius of the crust was 0.864 - 0.904 while the correlation coefficient was 0.907. This is consistent with Table (2) which indicates that annual increases in length are irregular.

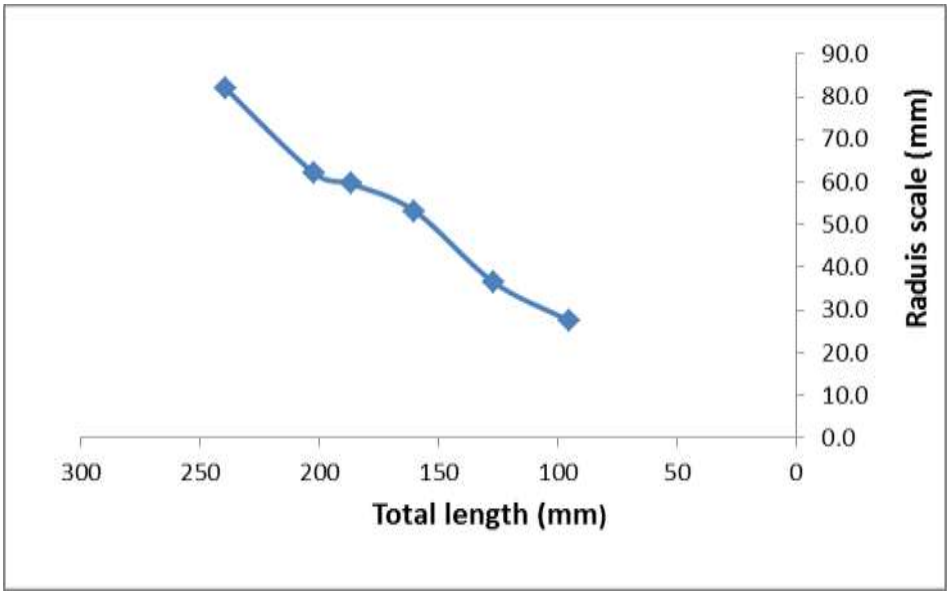

Figure 4: The exponential relationship between the total length mm and diameter of the scale (mm)

Condition factor

The Condition factor of Nile tilapia in the Tigris River is 2.67, which indicates that the growth and health status is good because of the fish's fullness. This indicates that the environmental conditions of the water are suitable for the livelihood of Nile tilapia because it provides sufficient food and suitable environmental characteristics and happened Njiru et. al, (2006), on the status factor of Nile tilapia in Lake obtained in Victoria, Kenya 0.92 - 1.07 The lake may be poor for food fish needs. Nutrition intensity, sexual maturity and fishing time have a direct impact on the status factor of fish. The results of the current study differed with Ighwela (2011). Where the coefficient of circumstance for Nile tilapia was found to be between 1.64, 1.77, 1.74, 1.72 and 1.79, which indicated good health condition during the experiment and it is indicating an isometric growth. I found the maximum expected length L_∞ the Nile tilapia in the Tigris River reached 293.68 mm and the values of the growth indicators K 0.108 and t_o 0.27 respectively were recorded. The L value indicates the length of life of the fish and is inversely correlated with the value of k, It takes longer to reach the L_∞ value and has a lower k compared to short-lived fish that have a high k value and reach L in a short time and k is associated with the temperature directly. $L_t = 293.68[(1-e^{0.108 (t + 0.27)}]$ For the purpose of describing the growth, the Bertlanvi equation was applied. the Nile tilapia in Mexico City ponds reached the standard length (Flores ,1994) found 20.7 mm with a coefficient of growth 0.2038 ، Gomez-marquez (2007) obtained the maximum expected length L(17.88 mm) and growth coefficient of K(0.3409) and to (-1.543).

Fish samples were collected as one sample per month during which 169 fish were harvested during the study period, which were divided into 11 individuals with length ranges of 66 to 274 mm and total weights from 6.6 to 378.79 g. Figure(5) The most tilapia community in the Tigris River, a small prepared under the total length of 200 mm and total sovereignty was set length 161-180 mm and a length at least the highest number is the length of the range 261-280 mm This is due to the means used fishing nets as well as slot. The results of the study differed with Kadouri (2012). The total length of the *zillii Tilapia* was 120-129 mm, 130-139 mm and the length range was 140-149 mm in most months. The dominance of this group in the two points indicates a new generation and supply. While the length range 180-189 mm less visible in the Hawib al-Swaib was limited to the month of February, while the range appeared in length 200-209 mm in Hor Ghatra during October and June.

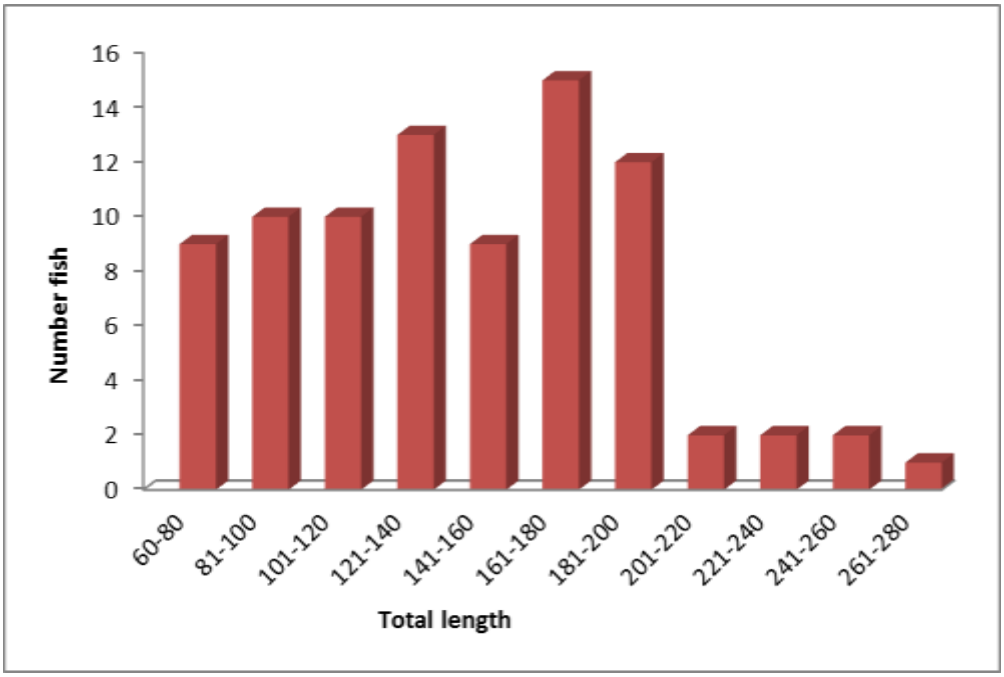

Figure 5: The frequency distribution of Nile tilapia length in the Tigris River

Conclusion

The length-weight relationship shows that growth is Allometric in Nile tilapia in the Tigris River. The Condition factor showed that the fish are in good health due to the availability of environmental and nutritional conditions.

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