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Study of Age, Growth and Some Population Dynamics Aspects of the Nile *Cyprinidae* Fish, *Labeo niloticus*, From the River Nile at El-Kanater El-Khyria, Egypt

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ABSTRACT

In the present work, certain biological characteristics of *Labeo niloticus* (Forsskål, 1775) of the main course of the River Nile at EL-Kanater EL-Khyria, Egypt were investigated during the period from August 2003 to August 2005. The length-weight relationship was found to be: log W (gm) = -2.27765 + 3.18395 log L (cm) and the condition coefficient (K) was 1.03. Age determination using annual rings of fish scales indicated that the longevity of this species reaches 6 years. The maximum increase in length was noted in the first age group. The von Bertalanffy growth equation was computed as: $L_t = 72.99 \{1 - e^{-0.355(t + 0.1789)}\}$ where the asymptotic length (L_∞) = 72.99 cm. Growth in length and weight were studied. Reproductive cycle including gonadosomatic index and the size and age at first sexual maturity were investigated. The body lengths at first sexual maturity (Lm_{50}) and first capture (L_c) were equal to 32 cm. Thus, it is recommended to prevent catching fish sizes less than 30 cm T.L. or 266.3 gm T.W. This is to give at least one time for the mature fish to spawn and to recruit the fish stock. The total mortality rate was 73% yearly, whereas, the estimated values for natural and fishing mortality coefficients were 0.64 and 0.66, respectively. The exploitation rate of the fish stock was 0.51. For proper management, the present level of exploitation rate should be reduced to maintain a sufficient spawning biomass. The length and age at first capture as well as that at recruitment were found to be L_c = 32.0 cm, t_c = 1.44 yr and L_r = 14.0 cm, t_r = 0.42 yr, respectively. The growth performance of *Labeo niloticus* (ϕ = 3.28) was the highest in comparison with other localities.

Key words: Age and growth, Egypt, EL-Kanater EL-Khyria, *Labeo niloticus*, mortality, population dynamics, reproduction, River Nile.

INTRODUCTION

The river Nile, which has sustained man's early civilization since its existence, is the main source for water in Egypt and is the origin of its fertile land. It provides Egypt with 98% of its water supply (Said, 1981). The studies done after the construction of Aswan Dam (1912) and the Aswan High Dam (1964) revealed progressive decrease in the number of fish species found in the Nile. The effect of flood retention harmed all the fisheries and disturbed the percentage composition of the fish species in the commercial catch. Many fish species disappeared, others began to show a marked decline, especially in the downstream areas where water is almost lentic (Bishai and Khalil, 1997).

Boulenger (1907) mentioned that Loat in his survey, during 1899-1902, recorded 85 species inhabiting the Egyptian Nile waters. On the contrary, in Bishai and Khalil (1997) recorded only 71 fish species during their survey of the Nile system in Egypt, 22 species are common in the commercial catch while 49 are rare. One of the most common species is *Labeo niloticus*.

The cyprinid fish *Labeo niloticus*, locally known as Lebeis, is one of the most common fish of family *Cyprinidae* in Egypt. It is distributed along the River Nile and Lake Nasser, but it used to be common in other lakes such as Manzala, Burullus, and Idku, during flooding time (Bishai and Khalil, 1997). In the past, *Labeo niloticus* played an important role in the fishery of the River Nile (Tharwat and El-Dawi, 1997). Its yield was about 24% and 18% of the total catch during 1965 and 1966, respectively (Hashem, 1972). In Cairo sector, this species contributed about 9.7% to the annual Nile catch in 1972 (Labib, 1979). In 1996, the yield of *Labeo niloticus* sharply decreased about 2% (1441 tons) of the total River Nile catch in Egypt (Bishai and Khalil, 1997). This was attributed to an increase in the mortality rates, caused by the excessive intrusion of indeterminate amounts of pollutants into the River Nile (Tharwat and El-Dawi, 1997) and from over-fishing.

Because of their great importance, the members of the family *Cyprinidae* received extensive scientific investigations all over the world (Schrank and Guy, 2002; Dadebo *et al.,* 2003; Briton and Harper, 2005; Rutaisire and Booth, 2005), and in Egypt (Mahmoud, 1992; Mekkawy and Mahmoud, 1992; Khallaf and Alne-na-ei, 1993; Alne-na-ei, 1994; Khallaf and Alne-na-ei, 1997). However, in literatures dealing with the biology of different species, very little was carried out on *Labeo niloticus* to ascertain its age and growth. Hashem (1972), Labib (1979), Soliman (1981), Khallaf and Alne-na-ei (1995), and Tharwat and El-Dawi (1997) studied the age and growth of *Labeo niloticus* in the Nozha-Hydrodrome, River Nile, Wadi El-Rayan Lake, Bahr Shebeen Canal and the River Nile (at Cairo and Giza), respectively. Furthermore Kamel *et al.* (1973) studied the food and feeding habits of *Labeo niloticus* in River Nile; Hashem (1973) studied the feeding and fatness of *Labeo niloticus* in the Nozha-Hydrodrome; and EL-Maghraby and Abdel-Rahman (1984) studied its food and feeding habits in Jebel Aulia reservoir, Sudan. Babiker (1984) and Khallaf *et al.* (1996) studied its reproductive aspects in the White

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Nile and Bahr Shebeen, respectively. The taxonomic and biometrics of *Labeo niloticus* were carried out by Yoakim (1968), Latif (1974), and Reid (1985).

The Nile is considered as one of the major sources of fish production in Egypt. Although there are vast aquatic resources, the optimum utilization and the proper management of natural fisheries are urgently needed to increase fish production (EL-Bolock and EL-Sedfy, 1983). The demand for increasing fish production in Egypt has become a great necessity due to the rapid growth of its population, where fish are considered among the most important sources of animal protein in Egypt.

In the present investigation, it is intended to give an account of certain biological and population dynamics aspects of *Labeo niloticus* of the main course of the River Nile at EL-Kanater EL-Khyria area. Information about such aspects is considered essential for fishery management of such an economically important Nile *Cyprinidae* fish, as well as for its future exploitation in fish culture.

MATERIALS AND METHODS

El-Kanater El-Khyria region of the River Nile lies 30 Kilometers to the north of Cairo. Specimens of *Labeo niloticus* used in the present work were collected monthly from the professional commercial fishing at various localities of the River Nile at El-Kanater El-Khiria region, between August 2003 and August 2005. This study was based on the examination of 446 fish (195 males and 251 females). Date of capture, total length (cm), body weight (gm), sex, maturity stage, and gonadal weight were recorded for each fresh specimen. Scales (10-20) from each specimen were taken from the left side of each fish from the region behind the pectoral fin between the dorsal fin and lateral line, as suggested by Rounsefell and Everhart (1953), and were put in envelopes with records on fish length, weight, sex, and date of capture. The scales were placed in solution of 10% of NH_4OH for 24 hours, then washed with distilled water, dried with filter paper, and mounted between two glass slides and examined for annuli reading and measurements. Age determination was based on the examination of the best three scales through a projector at X 10 magnification. Each scale was read twice and annuli were distinguished according to Lagler (1956).

The length-weight relationship

This relationship is determined by using the general parabola: W = a L^n, where W for weight (gm), L for total length (cm), a is constant and n is exponent value, as given by Le Cren (1951). This equation can also be expressed by the logarithmic transformation, Log W = log a + n log L.

Condition Coefficient

The condition factor, or the coefficient of condition, also known as the "K" factor, (Hile, 1936; Patterson, 1992), which expresses the relation between length and weight and measures the well-being of fish was calculated by two different methods as proposed by Bagenal and Tesch (1978) :

$K_1 = 100 \times W / L^n$ Fulton (1902)

$K_2 = 100 \times W / L^3$ Beckman (1948) and Jones (1976)

Where, **W** = fish weight (gm), **L** = Fish length (cm), and n is the exponent of the general length-weight equation.

Length-scale radius relationship:

The Linear length-scale relationships were established by using the formula:

$$L = a + bS \quad \text{Lee (1920)}$$

Where **L** = fish length at capture (cm), **a** and **b** are constants, and **S** = scale radius (X10). The length at the time of annulus completion was determined by using the formula of Lee (1920):

$$L_n = a + (L_c - a)/S_c \times S_n$$

where, $\mathbf{L_n}$ is the calculated fish length in centimetres at annulus n, $\mathbf{S_n}$ is the scale radius at annulus n, $\mathbf{S_c}$ is the scale radius at capture, $\mathbf{L_c}$ is the length of fish at capture, and **a** is the y-intercept. The back calculation of the length at each annulus was done by using the formula relating scale radius to body length and the equation of Lee (1920). The estimation of general growth in length was based on the grand average of back-calculated lengths and the successive summations of the grand average increments of back-calculated lengths. The growth in weight was studied from calculated weights corresponding to back-calculated lengths attained at the end of each year of life using the length-weight relationship equation.

Growth in length and weight

The theoretical growth in length was determined by the equation of von Bertalanffy (1938) as mentioned in Gulland (1965). The common forms of this equation were as follows:

$$L_t = L_\infty \left\{1 - e^{-k(t-t_0)}\right\} \text{ and}$$

$$L_{t+1} = L_\infty \left(1 - e^{-k}\right) + L_t e^{-k}$$

where, $\mathbf{L_t}$ is the length of fish in centimetres at age t, $\mathbf{L_\infty}$ is the maximum asymptotic length (i.e. the theoretical length beyond which the fish would not grow), **K** is the Brody's coefficient of growth constant, **t** is the age in years, $\mathbf{t_o}$ is the theoretical time at which the fish would have been of zero size if it had always grown according to the equation, and **e** is the logarithmic constant. The growth in weight was studied from calculated weights corresponding to calculated lengths attained at the end of each year of life using the length-weight relationship equation. Consequently, the von Bertalanffy equation is transformed by Ricker (1975) into:

$$W_t = W_\infty \left\{1 - e^{-k(t-t_0)}\right\}^n$$

Where, $\mathbf{W_t}$ = weight at time *t*, $\mathbf{W_\infty}$ = asymptotic weight, and **n** = is the exponent value of length-weight relationship.

Mortality rates

The total instantaneous mortality rate (Z) was calculated from the catch curve using the least square regression of the natural log (Ln) of the numbers in age groups on age (Sparre *et al.*, 1989). The plot of $\log_e$ of frequency at different age-groups is used to calculate a straight line for which the slope would be -Z. Hence, the survival and mortality rates would be calculated as follows:

$$S = e^{-z} = 1 - A$$

Where, **S** = Annual survival rate, **A** = Annual mortality rate, and **Z** = Instantaneous mortality rate.

1- Instantaneous natural mortality rate (M)

It is difficult to obtain a precise estimate of this parameter, and the only accurate method is when there is no fishing and consequently Z = M (Ricker, 1975; Sparre *et al.,* 1989; Khallaf, 1992). However, the method for obtaining an estimate of M was used in this study according to Pauly (1980), who made a regression analysis of M (per year) on K (per year), L_∞ (cm) and T (average annual temperature at the surface in degrees centigrade); as follows:

$$In\ M = -0.0152 - 0.279*ln\ L_\infty + 0.6543*ln\ K + 0.463*ln\ T$$

Where $\mathbf{L_\infty}$, K are von Bertalanffy equation constants and **T** is the average annual surface temperature in centigrade which equals to 22.9 °C (present study).

2- The fishing mortality (F)

It was calculated as F = Z - M (Beverton and Holt, 1957). The expectation of death due to fishing or what is known as Exploitation ratio (E = F / Z) was calculated according to Gulland (1971, 1983) and Pauly (1980, 1983), where (Z) and (F) are the total and fishing mortality coefficients, respectively. The length at first capture *(L_c)* was estimated using the length selection catch curve method (Lee and Baddar, 1989; Tharwat and El-Dawi, 1997). The corresponding age *(t_c)* was obtained by converting L_c using the von Bertalanffy growth equation [$t_c = -1 / K\ Ln\ (1 - L_c / L_\infty) + t_0$]. *The* length at recruitment *(L_r)* was determined as mentioned by Tharwat and El-Dawi (1997), and by Tharwat *et al.* (1998). The age at recruitment *(t_r)* was obtained by converting L_r using von Bertalanffy growth constants.

Maximum age (t_{max})

It is a measure of the longevity of the fish species. According to Pauly (1983), it is calculated as follows:

$$t_{max} = 3/k + t_o$$

Where **K** and $\mathbf{t_o}$ are von Bertalanffy equation constants.

Growth performance index (ϕ)

For comparing the overall growth performance of the fish species, this index is used because it is the best one for expressing fish growth (Pauly and Munro, 1984). It calculated as follows:

$$\phi = log_{10}\, k + 2\ log_{10}\, L_\infty$$

Where **K** and $\mathbf{L_\infty}$ are von Bertalanffy equation constants.

The gonadosomatic index (GSI)

To evaluate the state of maturity of the gonads, the gonado-somatic index (G.S.I.) was calculated for each specimen using the following equation:

G.S.I. = weight of ovary x 100 / total body weight of fish

The length at first maturity (L_{m50}) was determined from the plot of cumulative percentage of maturation against the corresponding lengths (Sparre *et al.,* 1989). The age at first maturity (t_{m50}), the age when 50% of the population is mature (also called the age of massive maturation), was obtained by converting L_{m50} using von Bertalanffy equation (Sparre *et al.,* 1989).

Water temperature

Monthly average of water temperature (°C) was measured, using an ordinary thermometer (range: 0-100°C, graduation interval: 0.1°C).

Statistics

All statistical analyses were calculated using the computer program of SPSS Inc. (version 14.0 for Windows) at the 0.05 level of significance.

RESULTS

Length-Weight relationship

The examination of the data obtained for the weights of *Labeo niloticus* revealed no significant difference between males and females. Therefore, the following determination of the length-weight relationship was based on the combined data for all fish collected from the River Nile at EL-Kanater El-Khyria irrespective of time or sex (Table 1 and Fig. 1). The regression equation defined by the method of least squares gave the relationship between weights, ranging from 28 to 3275 gm, and total lengths, ranging form 14 to 66 cm. Accordingly, the following equations were predicted:

$$Log\ W = -2.27765 + 3.18395\ log\ L$$

(r^2 = 0.999; SE of "n" = 0.0158)

or $W = 0.5277 \times 10^{-3}\ L^{3.18395}$

W: fish weight in grams, **L**: its total length in centimetres.

Condition Coefficient

The condition coefficients (K_1 and K_2) of *Labeo niloticus* (Table 1 and Fig. 2) were computed for each length interval. It was clear that the values of K_2 were higher than those of K_1. The values of K_2 fluctuated between 0.85 and 1.25, while those of K_1 ranged from 0.49 to 0.63 with a grand average of 0.53 and 1.03 for K_1 and K_2, respectively. Wave various fluctuations observed in the values of the condition coefficients (K_1 and K_2) with respect to the fish length of *Labeo niloticus*

Age and Growth

The growth in length and weight study of the *Labeo niloticus* was made by determining the actual growth in length and weight at the time of capture classified on

Table (1): Total length-weight relationship and condition factor of *Labeo niloticus* from River Nile at EL-Kanater EL-Khyria.

Total Length (cm)	No. of Fish	Weight (gm)		Advantage of weight	Condition factor	
		Empirical	Calculated		K_1	K_2
14	6	28.29	23.53	+ 4.76	0.63	1.03
15	6	32.66	29.31	+ 3.35	0.59	0.97
16	7	36.24	35.99	+ 0.25	0.53	0.88
17	6	44.65	43.66	+ 0.99	0.54	0.91
18	12	49.68	52.37	- 2.69	0.50	0.85
19	11	61.35	62.21	- 0.86	0.52	0.89
20	10	70.36	73.24	- 2.88	0.51	0.88
21	14	80.53	85.55	- 5.02	0.50	0.87
22	12	95.50	99.21	- 3.71	0.51	0.90
23	14	112.85	114.30	- 1.45	0.52	0.93
24	15	132.73	130.88	+ 1.85	0.54	0.96
25	17	150.42	149.05	+ 1.37	0.53	0.96
26	15	168.83	168.87	- 0.04	0.53	0.96
27	16	193.65	190.44	+ 3.21	0.54	0.98
28	12	212.36	213.81	- 1.45	0.52	0.97
29	15	237.58	239.09	- 1.51	0.52	0.97
30	12	269.20	266.34	+ 2.86	0.53	1.00
31	9	302.85	295.65	+ 7.20	0.54	1.02
32	10	316.42	327.10	- 10.68	0.51	0.97
33	13	358.37	360.77	- 2.40	0.52	1.00
34	10	398.16	396.75	+ 1.41	0.53	1.01
35	11	413.92	435.11	- 21.19	0.50	0.97
36	16	452.13	475.94	- 23.81	0.50	0.97
37	13	478.25	519.32	- 41.07	0.49	0.94
38	12	543.40	565.34	- 21.94	0.51	0.99
39	9	567.43	614.09	- 46.66	0.49	0.96
40	9	642.40	665.64	- 23.24	0.51	1.00
41	5	665.62	720.08	- 54.46	0.49	0.97
42	7	765.60	777.51	- 11.91	0.52	1.03
43	8	765.60	838.00	- 22.80	0.51	1.03
44	5	815.20	901.64	+ 10.59	0.53	1.07
45	5	912.23	968.51	- 20.51	0.52	1.04
46	7	948.00	1038.72	- 23.42	0.52	1.04
47	4	1015.30	1112.34	- 31.82	0.51	1.04
48	7	1080.52	1189.46	- 59.06	0.50	1.02
49	8	1130.40	1270.16	- 8.16	0.52	1.07
50	7	1262.00	1354.55	- 24.55	0.52	1.06
51	5	1330.00	1442.71	+ 2.79	0.53	1.09
52	8	1445.50	1534.72	- 0.24	0.53	1.09
53	6	1534.48	1630.68	- 60.03	0.51	1.05
54	5	1570.65	1730.67	- 10.67	0.52	1.09
55	5	1720.00	1834.80	+ 45.20	0.54	1.13
56	6	1880.00	1943.14	+ 7.72	0.53	1.11
57	5	1950.86	2055.79	+ 69.71	0.55	1.15
58	4	2125.50	2172.84	+ 257.66	0.59	1.25
59	4	2430.50	2294.38	+ 183.62	0.57	1.21
60	5	2478.00	2420.50	+ 147.50	0.56	1.19
61	4	2568.00	2551.30	+ 98.70	0.55	1.17
62	4	2650.00	2686.87	+ 58.13	0.54	1.15
63	4	2745.00	2827.30	+ 28.15	0.53	1.14
64	3	2855.45	2972.68	+ 214.82	0.57	1.22
65	3	3187.50	3123.10	+ 151.90	0.55	1.19
66	2	3275.00	3278.67	+ 43.83	0.53	1.16
Total	*446*		*Average*	*0.53*	*1.03*	

$K_1 = W / L^n \times 100$, n = 3.1839, and $K_2 = W / L^3 \times 100$.

the basis of annuli in different age groups; and by back- calculating the total length and weight using total length scale radius relationship and weight-length relationship.

Labeo niloticus scales are typically cycloid. The annual rings are easily differentiated for age groups 1^+ to 6^+. The annual rings which are close to each other are

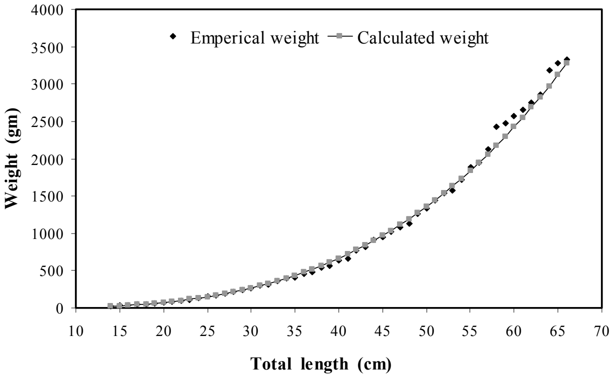

Figure (1): Total length-Weight relationship of *Labeo niloticus* from River Nile at EL-Kanater EL-Khyria.

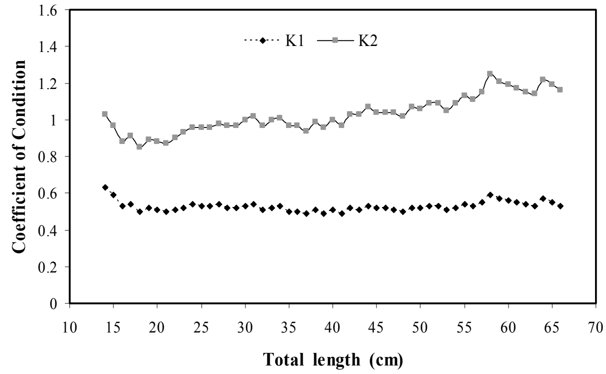

Figure (2): Variations of condition coefficients (K1 and (K2) for the different lengths of *Labeo niloticus* from River Nile at EL-Kanater EL-Khyria.

differentiated with difficulty. Accessory rings were observed; these rings are formed during spawning time.

Examination of the scales of *Labeo niloticus* revealed that annulus formation takes place in April. It is evident that the relationship between body length and scale radius is represented by a straight line that does not pass through the origin. The linear total length-scale radius relationship was established and the formula was found to be:

$$TL = 9.247 + 0.349\ SR$$

(r^2 = 0.996, standard error of "b" = 0.003), Where, **TL** is the fish total length (cm) and **SR** is the scale radius (X10).

The length at the time of annulus completion was determined using the formula of Lee (1920) where the following equation was adopted for the back-calculation of length at different scale annuli:

$$L_n = 9.2 + (L_c - 9.2)/S_c X\ S_n$$

Accordingly, the Y-intercept (correction factor) was considered as 9.2 cm (Fig. 3).

Back-calculated growth

The mean back-calculated lengths at the end of different years of life for male, female, and combined sexes are shown in Figure (4) and Table (2). The results indicated that the maximum life span of *Labeo niloticus* is six years and it attains 25.9, 41.6, 48.9, 53.9, 60.6 and

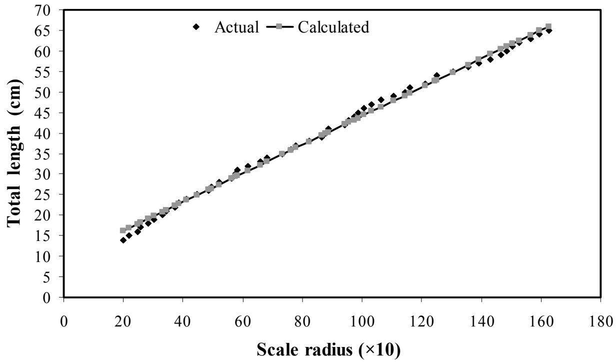

Figure (3): Total length-scale radius relationship of *Labeo niloticus* (irrespective of sex or time) from River Nile at EL-Kanater EL-Khyria.

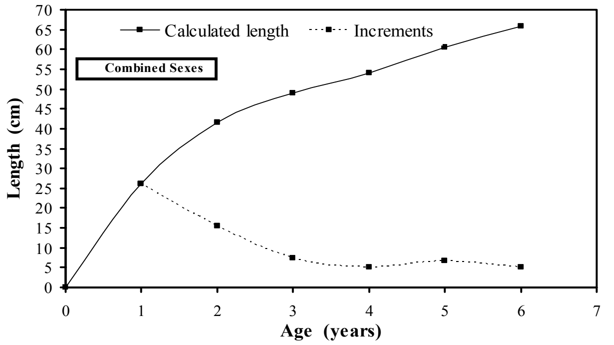

Figure (4): Back-calculated lengths and increments of *Labeo niloticus* (combined sexes) from River Nile at EL-Kanater EL-Khyria.

65.8 cm total length at the first to six years of life for the combined sexes. The annual increment in length of this species is relatively high and the highest value occurs during the first year of life where it attains 39.5% of its length at age VI. It decreases gradually with the increase in age till age group IV, and then it increases at the age group V, which has 10.1% of its length at age VI, and it decreases again at age group VI, which has 7.9% of its length at age VI.

The calculated weights for the back-calculated lengths at the end of the six age groups of the fish life span of male, female, and combined sexes are given in Table (3) and Figure (5). The results show that the calculated weights of *Labeo niloticus* were 188.3, 766.4, 1305.9, 1722.1, 2302.3, and 3119.1 gm for age groups I to VI. With growth increment in weight, a minimum annual increment (188.3 gm) is noticed during the first year of life and it increases with the increase in age to reach a maximum value (816.8 gm) at after six years of life, with the exception of age groups III and IV, where its values are 539.5 and 416.2 gm, respectively. The back-calculated lengths and weights accord with the observed lengths and weights for the different age groups of *Labeo niloticus*.

Von Bertalanffy growth in length

The growth pattern was then described by the von Bertalanffy growth model (von Bertalanffy, 1938) to describe the theoretical growth of *Labeo niloticus.*

Table (2): Average total length at capture (cm) and calculated total length (cm) at the end of each year of life of male, female and combined sexes of *Labeo niloticus* and percentage of annual increments

Age Group	No. of Fish	Average length at capture (cm)	Mean back calculated length at the end of year					
			1	2	3	4	5	6
Male								
0	22	20.78						
I	25	30.97	24.60					
II	74	42.85	26.08	40.71				
III	70	51.42	26.47	42.40	48.88			
IV	2	53.27	27.68	40.97	48.09	52.05		
V	1	57.65	24.57	41.87	49.48	54.12	58.77	
VI	1	66.43	25.66	41.05	51.11	55.27	64.38	66.56
Total Average length	*195*		*25.84*	*41.40*	*49.39*	*53.81*	*61.57*	*66.56*
Average annual increment			*25.84*	*15.56*	*7.99*	*4.42*	*7.76*	*4.99*
% annual increment			*38.82*	*23.38*	*12.00*	*6.64*	*11.66*	*7.50*
Female								
0	13	21.20						
I	28	31.06	24.44					
II	105	40.23	26.28	40.56				
III	100	50.03	25.65	41.85	47.26			
IV	2	55.46	26.83	41.99	49.52	53.21		
V	2	61.85	26.72	42.83	48.30	54.04	58.09	
VI	1	66.26	27.13	41.56	49.27	55.26	61.28	65.06
Total Average length	*251*		*26.17*	*41.76*	*48.59*	*54.17*	*59.68*	*65.06*
Average annual increment			*26.17*	*15.59*	*6.83*	*5.58*	*5.51*	*5.38*
% annual increment			*40.22*	*23.96*	*10.50*	*8.58*	*8.47*	*8.27*
Combined sexes								
0	35	20.40						
I	53	32.52	24.51					
II	179	40.54	26.17	40.63				
III	170	49.73	26.05	42.13	47.68			
IV	4	54.87	27.25	41.48	49.20	52.63		
V	3	59.75	25.63	42.35	48.89	54.07	58.42	
VI	2	66.35	26.34	41.30	50.19	55.26	62.82	65.81
Total Average length	*446*		*25.99*	*41.58*	*48.99*	*53.99*	*60.62*	*65.81*
Average annual increment			*25.99*	*15.59*	*7.41*	*5.00*	*6.63*	*5.1 9*
% annual increment			*39.49*	*23.69*	*11.26*	*7.60*	*10.07*	*7.89*

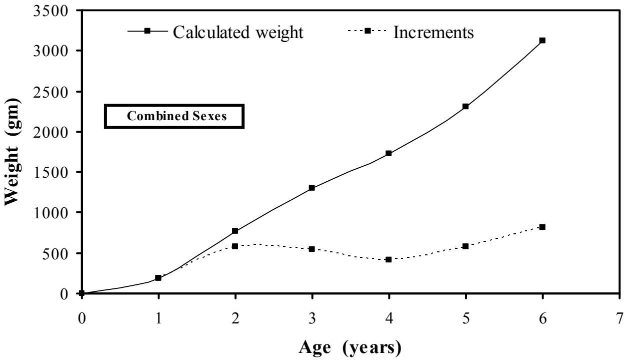

Figure (5): Back-calculated weights and increments of *Labeo niloticus* (combined sexes) from River Nile at EL-Kanater EL-Khyria.

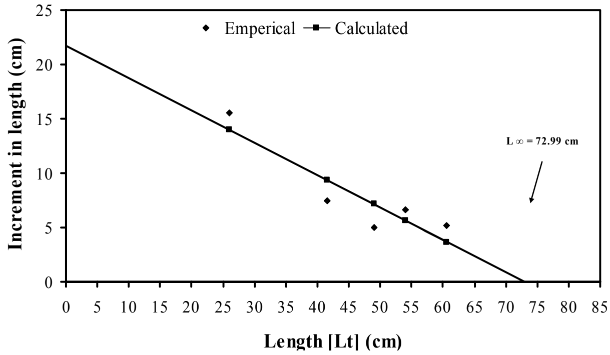

Figure (6): Relationship between length (Lt) and increment in length of *Labeo niloticus* from River Nile at EL-Kanater EL-Khyria.

Following Gulland (1969), the plot of length increment against initial length (L_t) followed a straight line, which could be described by the following equation:

$$Increment\ (cm) = 21.73 - 0.298\ L_t\ (cm)$$

(r^2 = 0.82, standard error of "b" = 0.082). The x-axis intercept of this equation could be estimated exactly by the equation -a/b. This would give the asymptotic length (L_∞) of 72.99 cm (Fig. 6). On the other hand, the relationship between Ln (L_∞ - L_t/L_∞) against time in years (Fig. 7) gave the following equation:

$$Ln\ (L_\infty - L_t/L_\infty) = -0.0635 - 0.3550\ t$$

(r^2 = 0.980, standard error of "b" = 0.025), where, **t** = is the age in years.

Consequently, t_o, the time at which the fish form scales, equal -a/b and it was found to be –0.1789. The slope of that line equals -K, the Brody's coefficient of growth, which was 0.3550. Accordingly, the growth of *Labeo niloticus* was described by the following von Bertalanffy growth equation:

$$L_t = 72.99\ \{1 - e^{-0.355(t\ +\ 0.1789)}\}$$

The application of the first form of that equation gave estimated lengths at different ages and was found to be: 25, 39.3, 49.4, 56.5, 61.4, and 64.9 cm for age groups I to VI, respectively. The equation of theoretical growth

Table (3): Average calculated weights for males, females, and combined sexes of *Labeo niloticus* at the end of each year of life of male, female and combined sexes of *Labeo niloticus* and percentage of annual increments

Male								
Age Group	**No. of Fish**	**Average weight at**	**Mean back-calculated weight at the end of year**					
			1	2	3	4	5	6
0	22	127.3						
I	25	190.6	158.72					
II	74	715.4	208.42	737.26				
III	70	1298.1	200.92	776.66	1220.53			
IV	2	1728.5	212.62	758.26	1323.03	1575.21		
V	1	2251.7	145.62	765.46	1325.63	1728.01	2092.52	
VI	1	3199.8	170.52	757.46	1450.33	1817.41	2651.42	3291.95
Total Average weight	*195*		*182.80*	*759.02*	*1329.88*	*1706.88*	*2371.97*	*3291.95*
Average annual increment			*182.80*	*576.22*	*570.86*	*377.00*	*665.09*	*919.98*
% annual increment			*5.55*	*17.50*	*17.34*	*11.45*	*20.21*	*27.95*
Female								
Age Group	**No. of Fish**	**Average weight at**	**Mean back-calculated weight at the end of year**					
			1	2	3	4	5	6
0	13	124.3						
I	28	192.8	165.41					
II	105	719.5	199.91	722.57				
III	100	1288.6	195.51	797.57	1234.70			
IV	2	1729.9	200.11	796.47	1349.20	1646.43		
V	2	2247.1	197.91	814.07	1250.90	1716.53	2096.72	
VI	1	3167.4	203.61	738.57	1293.30	1849.03	2368.42	2946.25
Total Average weight	*251*		*193.74*	*773.85*	*1282.02*	*1737.33*	*2232.57*	*2946.25*
Average annual increment			*193.74*	*580.11*	*508.17*	*455.31*	*495.24*	*713.68*
% annual increment			*6.58*	*19.69*	*17.25*	*15.45*	*16.81*	*24.22*
Combined sexes								
Age Group	**No. of Fish**	**Average weight at**	**Mean back-calculated weight at the end of year**					
			1	2	3	4	5	6
0	35	126.1						
I	53	191.7	162.07					
II	179	718.50	204.17	729.93				
III	170	1294.35	198.17	787.13	1227.60			
IV	4	1730.4	206.37	777.33	1336.10	1613.83		
V	3	2254.2	171.77	789.73	1288.30	1716.23	2094.62	
VI	2	3185.6	187.07	748.03	1371.80	1836.23	2509.92	3119.10
Total Average weight	*446*		*188.27*	*766.43*	*1305.95*	*1722.10*	*2302.27*	*3119.10*
Average annual increment			*188.27*	*578.16*	*539.52*	*416.15*	*580.17*	*816.83*
% annual increment			*6.04*	*18.54*	*17.30*	*13.33*	*18.60*	*26.19*

in weight was obtained by applying the length-weight relationship equation to the growth in length equation as follows:

$$W_t = 4517.5\ [1\text{-}e^{-0.355\,(t\,+\,0.1789)}]^{\ 3.1839}$$

The results in Table (5) show a close agreement between both of the theoretical and back-calculated growth in length and weight of *Labeo niloticus* for different age groups.

Fish population dynamics

A- Age composition:

The age composition of *Labeo niloticus* was investigated and the percentage of fish in each age group was examined (Fig. 8). The data revealed that age group (0) is the least, and contributed about 4.93, 2.91, and 7.85 for males, females and combined sexes, respectively. The frequency of fish in the age groups II and III dominate the catch and constitute about 40.13 and 38.12% for combined sexes, respectively.

B- Mortalities and rate of exploitation:

The catch curve was shown in Figure (9). The descending right portion of this curve followed a straight line over age groups from II to VI. The calculated equation for the combined sexes is:

$$Log_e\,(N) = 7.9105 - 1.3026\ T$$

(r^2 = 0.83, standard error of "b" = 0.3402, n = 5); where: **N** = frequency, **T** = age in years. The slope of this line equals (-Z). Therefore, the instantaneous mortality rate [Z] would be: Z = 1.303 and the survival rate [S] = e^{-z}, and this will be 0.27, consequently, the annual mortality rate [A] = l-S, then: A equals 0.73.

Inserting the growth parameters of von Bertalanffy equation (L_∞, k) and the annual water temperature of the study area (average, 22.9°C) in the equation of Pauly (1980), we obtained the value of natural mortality (M). The value of natural mortality (M) and the expectation of deaths due to natural causes amounted to 0.64. By subtracting the obtained value of (M) from (Z) we obtained the estimate of fishing mortality (F), it was found to be 0.66. The exploitation ratio (E) was found to be equal to 0.51.

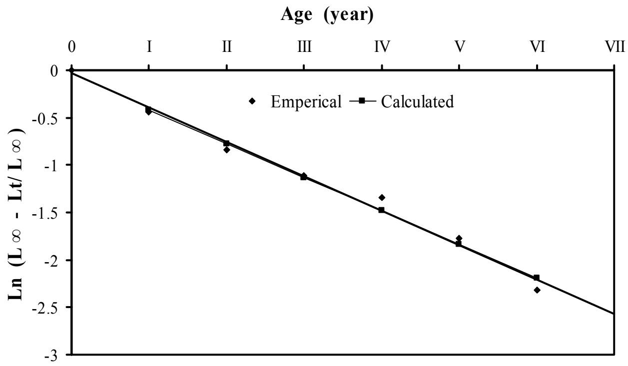

Figure (7): Relation between age (year) and Ln (L ∞ - Lt/L ∞) of *Labeo niloticus* from River Nile at EL-Kanater EL-Khyria.

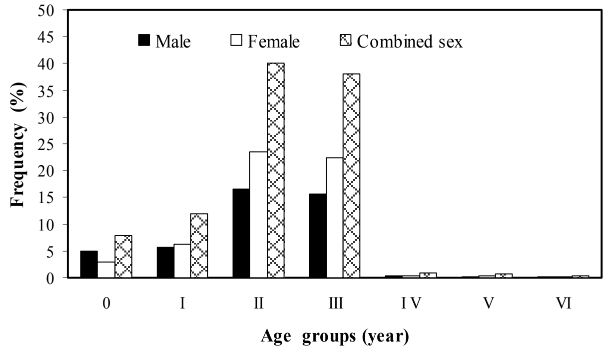

Figure (8): Percentage of age composition of *Labeo niloticus* from River Nile at EL-Kanater EL-Khyria.

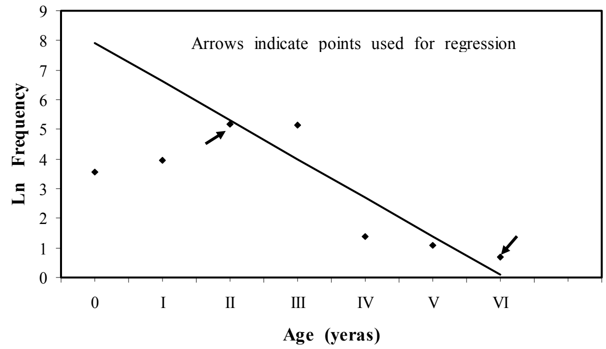

Figure (9): Catch curve of *Labeo niloticus* from River Nile at EL-Kanater EL-Khyria.

Table (4): Comparison of the condition factor (K_1 and K_2) and the parameters of the regression ($W = a\ L^n$) between total length (L. cm) and weight (W. gm) and the test of equality among different regression coefficients (n) of length-weight relationships of *Labeo niloticus* from different localities.

Locality	K_1	K_2	a x 10^{-3}	n	S.E. (n)	r	r^2
River Nile at EL-Kanater EL-Khyria (present study)	0.53	1.03	0.5277	3.1839	0.0158	0.999	0.999
Nozha-Hydrodrome (Hashem, 1972)	0.53	086	0.5247	3.1407	0.0229	0. 998	0.998
River Nile from Assiut to Cairo (Labib, 1979)	0.94	1.07	0.9281	3.0369	0.0250	0.997	0.995
Bahr Shebeen Canal (Khallaf and Alne-na-ei, 1995)	0.69	1.05	0.6750	3.1270	0.0189	0.999	0.998
River Nile at Cairo and Giza sectors (Tharwat and El-Dawi, 1997)	0.76	0.82	0.7621	3.0250	0.0173	0.997	0.995

Test of Equality

Source of variation	df	Sum of squares	Mean squares	F
Among n's (variation among regression)	4	0.041076	0.010269	6.130 *
Average variation within regression	217	0.3635	0.001675	

**Significant at 0.05 level.*

Table (5): A comparison of average back-calculated and von Bertalanffy lengths and weights at the end of different year of Life of *Labeo niloticus* from different localities.

Average Back-calculated length (cm)

Locality		Age group (year) 1	2	3	4	5	6	7
River Nile at EL-Kanater EL-Khyria (present study)	Avg. L	25.99	41.58	48.99	53.99	60.62	65.81	-
	Incr.	25.99	15.59	7.41	5.00	6.63	5.19	-
Nozha-Hydrodrome (Hashem, 1972)	Avg. L	19.40	37.70	46.20	52.30	58.80	63.00	-
	Incr.	19.40	18.30	8.50	6.10	6.50	4.2	-
River Nile from Assiut to Cairo (Labib, 1979)	Avg. L	26.20	41.60	49.20	54.50	60.10	65.40	72.30
	Incr.	26.20	15.40	7.60	5.30	5.60	5.30	6.90
Bahr Shebeen Canal (Khallaf and Alne-na-ei, 1995)	Avg. L	19.88	32.57	42.96	48.74	54.53	-	-
	Incr.	19.88	12.69	10.39	5.78	5.79	-	-
River Nile at Cairo and Giza sectors (Tharwat and El-Dawi, 1997)	Avg. L	19.20	31.60	40.00	-	-	-	-
	Incr.	19.20	12.40	8.40	-	-	-	-

Average Back-calculated weight (gm)

Locality		Age group (year) 1	2	3	4	5	6	7
River Nile at EL-Kanater EL-Khyria (present study)	Avg. W	188.27	766.43	1305.95	1722.10	2302.27	3119.10	-
	Incr.	188.27	578.16	539.52	416.15	580.17	816.83	-
Nozha-Hydrodrome (Hashem, 1972)	Avg. W	58.00	480.00	980.00	1455.00	1912.00	2279.00	-
	Incr.	58.00	422.00	500.00	475.00	475.00	367.00	-
River Nile from Assiut to Cairo (Labib, 1979)	Avg. W	191.80	768.90	1272.00	1741.70	2327.00	2982.50	4107.87
	Incr.	191.80	577.10	503.10	469.70	585.30	655.50	1125.37
Bahr Shebeen Canal (Khallaf and Alne-na-ei, 1995)	Avg. W	78.90	369.30	878.00	1302.90	1850.90	-	-
	Incr.	78.90	290.40	508.70	424.90	548.00	-	-
River Nile at Cairo and Giza sectors (Tharwat and El-Dawi, 1997)	Avg. W	58.10	262.30	535.20	-	-	-	-
	Incr.	58.10	204.20	272.90	-	-	-	-

Von Bertalanffy length (cm)

Locality		Age group (year) 1	2	3	4	5	6	7
River Nile at EL-Kanater EL-Khyria (present study)	L	25.0	39.3	49.4	56.5	61.4	64.9	-
	Incr.	25.0	14.3	10.1	7.1	4.9	3.5	-
Nozha-Hydrodrome (Hashem, 1972)	L	17.5	35.5	47.0	54.5	59.2	62.3	-
	Incr.	17.5	18.0	11.5	7.4	4.8	3.1	-
River Nile from Assiut to Cairo (Labib, 1979)	L	25.8	38.6	48.5	56.2	62.2	66.9	70.5
	Incr.	25.8	12.7	9.9	7.7	6.0	4.7	3.6
Bahr Shebeen Canal (Khallaf and Alne-na-ei, 1995)	L	19.3	33.0	42.6	49.4	54.2	-	-
	Incr.	19.3	13.7	9.6	6.8	4.8	-	-
River Nile at Cairo and Giza sectors (Tharwat and El-Dawi, 1997)	L	19.2	31.6	40.0	-	-	-	-
	Incr.	19.2	12.4	8.4	-	-	-	-

Von Bertalanffy weight (gm)

Locality		Age group (year) 1	2	3	4	5	6	7
River Nile at EL-Kanater EL-Khyria (present study)	W	154.1	649.4	1333.8	2030.8	2643.2	3138.5	-
	Incr.	154.1	495.3	684.4	697.0	612.4	495.3	-
Nozha-Hydrodrome (Hashem, 1972)	W	94.2	450.2	943.4	1431.9	1846.0	2168.5	-
	Incr.	94.2	356.0	493.2	488.5	414.1	322.5	-
River Nile from Assiut to Cairo (Labib, 1979)	W	224.5	1018.9	2083.7	3119.4	3987.9	4659.7	5155.2
	Incr.	224.5	794.4	1064.8	1035.7	868.5	671.8	495.5
Bahr Shebeen Canal (Khallaf and Alne-na-ei, 1995)	W	106.3	504.7	1054.3	1597.4	2057.1	-	-
	Incr.	106.3	398.4	549.6	543.1	459.7	-	-
River Nile at Cairo and Giza sectors (Tharwat and El-Dawi, 1997)	W	58.2	262.4	535.2	-	-	-	-
	Incr.	58.2	204.2	272.8	-	-	-	-

Avg.=average, Incr.=Increment, L=length (cm), W=weight (gm)

C- Length and age at first capture and at recruitment:

The size at first capture (L_c) is the size at which 50% of the fish retained by the gear was computed using the length selection catch curve method (Fig. 10). Its estimated value was 32.0 cm in total length and its calculated weight equals 327.1 gm. Converting this length (L_c) to the age at first capture (t_c) by using the von Bertalanffy equation gave t_c = 1.44 years.

The smallest size of *Labeo niloticus* that was represented in the catch is selected to be the size at recruitment. The length at recruitment (L_r) was found to be 14.0 cm in total length and its calculated weight equals 28.3 gm. The corresponding age at recruitment (t_r) is estimated from the von Bertalanffy equation as 0.42 year.

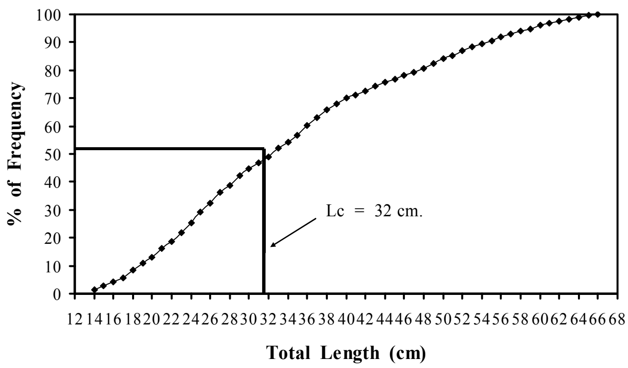

Figure (10): Cumulative length selection curve of *Labeo niloticus* in River Nile at EL-Kanater EL-Khyria showing the length at capture (Lc).

Maximum age (t_{max})

The value of maximum age (t_{max}) of *Labeo niloticus* was determined and found to be equal to 8.3 years (Table 6).

Growth performance index (ϕ):

The obtained results indicated that the growth performance index (ϕ) of *Labeo niloticus* was found to be 3.277 (Table 6).

Reproductive Biology

A- Gonado-Somatic Index:

The gonado-somatic index (G.S.I.) for both sexes of *Labeo niloticus* were graphically represented in figure (11).

The results show that the values are higher in females than in males during all months of the year. The highest values of G.S.I recorded in the spawning months (May, June, and July), represented by one peak in June, and were about 1.845 and 10.544 for males and females, respectively.

B- Age and Size at First Sexual Maturity:

Among the different sexes of *Labeo niloticus*, some variations are found in the size at first maturity. The smallest sizes of mature fish were 22, 24, and 26 cm in total length, which represent about 9.90%, 4.30%, and 15.80% of the mature males and females, respectively (Fig. 12). In the present investigation all males and females longer than 34 and 38 cm, respectively, are sexually mature. Figure (12) shows that the length at first sexual maturity (Lm_{50}) is 30 and 32 cm in total length for males and females, respectively. By converting these lengths to their corresponding weight and age, they gave 266.3 and 327.1 gm in total weight and 1.31 and 1.44 years for males and females, respectively.

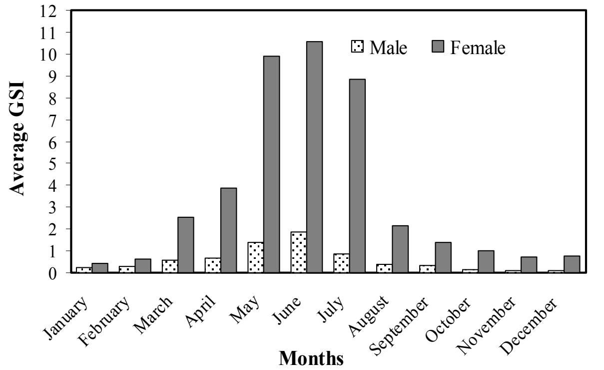

Figure (11): Monthly variations of the average of gonadosomatic index (GSI) of male and female *Labeo niloticus* from River Nile at EL-Kanater EL-Khyria.

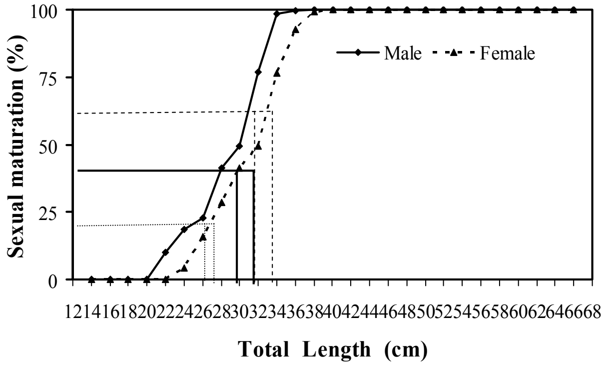

Figure (12): Size at first sexual maturity of male and female of *Labeo niloticus* from River Nile at EL-Kanater EL-Khyria.

Discussion

First of all, to compare the results of *Labeo niloticus* from the River Nile at EL-Kanater EL-Khyria (present study) with those from other localities, the different parameters of age, growth and population dynamics

Table (6): Comparison of the estimated population dynamic parameters of *Labeo niloticus* from different localities.

Locality	L_∞	W_∞	t_0	K	S	A	Z	M	F	E	tmax	ϕ	Lc	tc	Lr	tr	Lm_{50} (male)	Lm_{50} (female)	tm_{50} (male)	tm_{50} (female)
River Nile (present study)	72.99	4517.5	-0.1789	0.3550	0.27	0.73	1.303	0.64	0.66	0.51	8.3	3.277	32.0	1.44	14.0	0.42	30.0	32.0	1.31	1.44
Nozha (Hashem, 1972)	67.84	2965.3	0.3229	0.4417	0.32	0.68	1.127	0.72	0.40	0.36	7.1	3.308	37.2	2.12	12.0	0.76	45.0	47.0	2.79	3.00
River Nile (Labib, 1979)	83.26	6306.3	-0.4871	0.2510	0.53	0.47	0.637	0.50	0.14	0.22	11.5	3.241	34.0	1.61	10.0	0.03	—	—	—	—
Bahr Shebeen (Khalla and Alne-na-ei, 1995	65.63	3297.5	0.0065	0.3505	0.23	0.77	1.493	0.65	0.85	0.57	8.6	3.179	25.5	1.41	15.0	0.75	35.0*	34.2*	2.18	2.11
River Nile (Tharwat and El-Dawi, 1997)	57.60	1612.8	-0.0400	0.3901	0.19	0.81	1.660	0.73	0.93	0.56	7.7	3.113	26.00	1.50	15.0	0.73	27.0	31.0	1.58	1.94

* = After Alne-na-ei (1994).
L_∞ = Maximum asymptotic length (cm), the theoretical length beyond which the fish would not grow.
W_∞ = Asymptotic weight (gm).
t_0 = Age at which length is nil (year).
K = Brody coefficient of growth constant (year $^{-1}$).
S = Annual survival rate.
A = Annual mortality rate.
Z = Instantaneous mortality rate (year $^{-1}$).
M = Natural mortality coefficient (year $^{-1}$).
Lm_{50} = Length at first sexual maturity (cm), or the length when 50% of the population is mature.
F = Fishing mortality coefficient (year^{-1}).
E = The exploitation ratio.
tmax = Maximum age.
ϕ = Growth performance index.
Lc = Length at first capture (cm).
tc = Age at first capture (year).
Lr = Length at recruitment (cm).
tr = Age at recruitment (year).
tm_{50} = Age at first sexual maturity (cm), or the age when 50% of the population is mature.

(i.e. K_1, K_2, L_∞, W_∞, S, A, Z, M, F, E, t_{max}, ϕ, L_c, t_c, L_r, t_r, Lm_{50}, and tm_{50}) were calculated from the available data for those authors who did not mentioned it.

Length and weight data are standard results of fish sampling. Such data are essential for a wide number of studies, as estimating growth rate, age structure, and other aspects of fish population dynamics (Kohlr *et al.*, 1995). Length-weight relationship is well-described by the equation:

$$\log W = -2.27765 + 3.18395 \log L$$

$$\text{or } W = 0.5277 \times 10^{-3}\, L^{3.18395}$$

The value of the exponent (n = 3.184) shows that the weight of *Labeo niloticus* in the River Nile increases to a power greater than the cube of the length and this indicates that the shape changes rapidly as the fish grows in length, and also this indicates that the condition of fish is very good in that environment or attributed to the morphological characters of the species (Tharwat and El-Dawi, 1997).

This regression parameter "n" between length and weight of *Labeo niloticus* was compared with those from other localities (Table 4). A significant difference (F = 6.13) was found to occur among the regression coefficients of the length weight relationships of fishes in comparison. This variation could be attributed to different stages in ontogenetic development as well as to differences in age, maturity, and sex. Geographic location and associated environmental conditions, such as season (date and time of capture), disease and parasite can also affect the value of (n) (Osman, 2005).

The weight at different length of *Labeo niloticus* from River Nile at EL-Kanater EL-Khyria is heavier when compared to other localities (Table 7) with the exception of Bahr Shebeen Canal 1995. The difference in weight becomes wider with the increase in length reaching its maximum of 482.1 gm at 65 cm length. The weight of Bahr Shebeen fish, compared to those of the River Nile at EL-Kanater EL-Khyria may be due to the riverine effect and food availability of Bahr Shebeen (Khallaf and Alne-na-ei, 1995). The high weight of *Labeo niloticus* from the River Nile at EL-Kanater EL-Khyria compared to those of Nozha-Hydrodrome may be attributed to environmental conditions of the Nile (running water), while the Nozha Hydrodrome (500 hectars) is a closed pond and considered as a fish farm (Tharwat and El-Dawi, 1997). The high weight of *Labeo niloticus* from the River Nile at EL-Kanater EL-Khyria compared to those of the River Nile in 1979 and 1997 may be attributed to the abundance of nutritious phytoplanktons in the River Nile water at EL-Kanater EL-Khyria (Siliem, 1994), and to the excessive intrusion of the pollutants into the River Nile especially in Cairo and Giza (Tharwat and El-Dawi 1997).

The condition coefficient is considered as a measure of the "fatness" of the fish in a population, and it may also be considered as a rough measure of the state of the fish, whether healthy or unhealthy, starved or well-fed, spawning or spent (Patterson, 1992).

The condition coefficient "K" of *Labeo niloticus* in the River Nile showed that the value of "K" increased with increasing fish length with some irregularity. The decreasing in K values with increasing length may be attributed to sexual maturation (Al-Ghais, 1993). By comparing the condition factor of *Labeo niloticus* in different regions, we can conclude that the condition factor (k_1) is clearly lower in the River Nile fish at EL-Kanater EL-Khyria region than in the others. On the other hand, the condition factor (k_2) is clearly higher in fishes of the River Nile at EL-Kanater EL-Khyria region

Table (7): Comparison of average weight (gm) at different lengths of *Labeo niloticus* from different localities.

Total length intervals (cm)	**Locality**								
	River Nile at EL-Kanater EL-Khyria (present study)	Nozha-Hydrodrome (Alexandria) (Hashem, 1972)		River Nile from Assiut to Cairo (Labib, 1979)		Bahr Shebeen Canal (Khallaf and Alne-na-ei, 1995)		River Nile at Cairo and Giza sectors (Tharwat and El-Dawi, 1997)	
	Weight	***Weight***	***Difference***	***Weight***	***Difference***	***Weight***	***Difference***	***Weight***	***Difference***
01 — 05	–	–	–	1.2	–	–	–	–	–
06 — 10	–	–	–	5.6	–	–	–	–	–
11 — 15	26.4	19.1	+ 7.4	23.2	+ 3.2	32.6	- 6.2	27.0	- 0.6
16 — 20	53.5	46.9	+ 6.6	61.4	- 7.9	58.9	- 5.4	47.5	+ 6.0
21 — 25	115.8	100.5	+ 15.3	128.3	- 12.5	126.0	- 10.2	100.8	+ 15.0
26 — 30	215.7	191.0	+ 24.7	232.2	- 16.5	232.4	- 16.7	181.3	+ 34.4
31 — 35	363.1	310.3	+ 52.8	381.7	- 18.6	387.9	- 24.8	300.1	+ 63.0
36 — 40	568.1	442.5	+ 125.6	585.0	- 16.9	602.5	- 34.5	458.5	+ 109.5
41 — 45	841.2	710.7	+ 130.4	850.7	- 9.6	886.6	- 45.4	621.6	+ 219.6
46 — 50	1193.1	1003.3	+ 189.7	1187.4	+ 5.7	1250.4	- 57.4	–	–
51 — 55	1634.7	1327.6	+ 307.1	1603.5	+ 31.2	1670.4	- 35.7	–	–
56 — 60	2177.3	1812.6	+ 364.8	2107.7	+ 69.6	2264.5	- 87.2	–	–
61 — 65	2832.3	2350.1	+ 482.1	2708.7	+ 123.6	–	–	–	–
66 — 70	3278.7	–	–	3366.5	- 87.8	–	–	–	–
71 — 75	–	–	–	4146.1	–	–	–	–	–
76 — 80	–	–	–	5175.1	–	–	–	–	–
81 — 85	–	–	–	5801.6	–	–	–	–	–

than that of Nozha (Hashem, 1972) and the Nile (Labib, 1979). This verifies the above mentioned finding that *Labeo niloticus* in the River Nile at EL-Kanater EL-Khyria region is heavier rather than Nozha (Hashem, 1972) and the Nile (Labib, 1979).

The determination of the age of fish is of great importance for solving the biological problems of fisheries. According to Brothers (1982), the time and period of annulus formation were the most important steps in aging fish from its hard structures. The annual rings of *Labeo niloticus* from EL-Kanater EL-Khyria region are formed on the scales during April. Present results are in agreement with those of Labib (1979), who stated that the annuli appear on the scales of *Labeo niloticus* in the River Nile during April. A comparison of the mean calculated length of each year-class at the time of annulus formation with the observed lengths of older fish at each age shows a very close agreement. Present results coincides with those of Tharwat and El-Dawi (1997), who attributed this to the fact that these fish were taken in late winter or early spring before the onset of the new growth.

Concerning the longevity of *Labeo niloticus*, it was found that the fish has a relatively long longevity, where it attained 6 years. On the other hand, it reached to 6, 7, 5 and 3 years in the Nozha Hydrodrome (Hashem, 1972), the River Nile stream from Cairo to Assiut (Labib, 1979), Bahr Shebeen Canal (Khallaf and Alne-na-ei, 1995), and the River Nile at Cairo and Giza sectors (Tharwat and El-Dawi, 1997), respectively. These significant variations are due to the changes in the fishing efforts and exploitation rate of the fishery resources, as well as over fishing throughout the past and present times.

The calculated lengths and weights of *Labeo niloticus* from the River Nile at EL-Kanater EL-Khyria region was compared with those of other Egyptian localities (Table 5). The results indicated that the growth in length and weight of the fish of the present study is higher than those of other sites with the exception of these fish of the Nile from Assuit to Cairo (Labib, 1979). The variations of weights at different lengths among different regions are mainly attributed to water temperature (Alliot *et al.*, 1983) and food availability (Wassef and El-Emary, 1989). It may also be attributed to the interplay between a complex of genotype, body size, physiological conditions of the fish and environmental conditions (Wootton, 1990).

Labeo niloticus from the River Nile at EL-Kanater EL-Khyria region is characterized by having the largest asymptotic length and weight (L_∞ = 72.99 cm and W_∞ = 4517.5 gm) in comparison with other localities, with the exception of those of the River Nile from Assiut to Cairo (Labib, 1979) where it was found to be 83.26 cm and 6306.3 gm for L_∞ and W_∞, respectively.

Present results indicate that the reproductive cycle of *Labeo niloticus* is represented by a single spawning season which extends from May to the end of July. This is in agreement with that reported by Labib (1979) and Tharwat and El-Dawi (1997) for the same species in the Nile water from Cairo to Assiut region, and at Cairo and Giza sectors, respectively.

The estimation of size at first sexual maturity (Lm_{50}) has its practical application in the determination of the minimum legal size needed to protect an adequate spawning stock and to ensure at least one spawning for the mature individuals (Ghorab *et al*., 1986). Present result revealed that for *Labeo niloticus,* the males in general attain maturity somewhat before the females where the smallest male attained first maturity at 30 cm in total length and age of 1.31 years, while the smallest female at 32 cm in total length and age of 1.44 years. The big size of *Labeo niloticus* from the River Nile at EL-Kanater EL-Khyria region at first sexual maturity (30 - 32 cm.) indicates that the protection of immature fish to preserve a spawning stock needs to be taken into consideration the management of the fishery.

The present results on age composition for *Labeo niloticus* from the River Nile at EL-Kanater EL-Khyria region (from zero to VI) were in disagreement with Tharwat and El-Dawi (1997) (from zero to III), while it was in agreement with the results of Hashem (1972) (from zero to VI), Labib (1979) (from zero to VII), and Khallaf and Alne-na-ei (1995) (from zero to V). The abundance of zero groups for *Labeo niloticus* indicates that the spawning grounds are probably their fishing grounds (Allam *et al.*, 1998).

The main causes of mortality in fish can be either natural or fishing mortality. The total mortality coefficient "Z", the natural mortality coefficient "M", and the fishing mortality coefficient "F" were estimated as 1.303, 0.64, and 0.66 per year respectively for *Labeo niloticus* from the River Nile at EL-Kanater EL-Khyria region (Table 6). *Labeo niloticus* was found to have a lower survival rate (S = 0.27), which means that about 27% of *Labeo niloticus* survive per year. Hence, the annual mortality rate (A) recorded is 0.73. This result was confirmed by Hashem (1972), Khallaf and Alne-na-ei (1995), and Tharwat and El-Dawi (1997), where the values of (S) and (A) of their results were S = 0.32, A = 0.68; S = 0.23, A = 0.77, and S = 0.19, A = 0.81, respectively.

The exploitation ratio (E) allows one to roughly assess whether the stock is overexploited or not, on the assumption that the optimal value of E is 0.5 for a stable fishery (Gulland, 1971). Exploitation ratio (E) in the present study is computed as 0.51 (Table 6), indicating that the stock of *Labeo niloticus* is slightly overexploited. This case may be caused by a high increase in the fishing effort and/or the unsuitable selectivity of the gears is still used in the River Nile (Tharwat and El-Dawi, 1997). The values of both fishing mortality and exploitation rates were relatively high indicating a high level of exploitation of *Labeo niloticus* under the current system and also illustrating the relatively low abundance of *Labeo niloticus* in the Nile fishery.

The length at first capture (the length at which 50% of the fish are vulnerable to capture) was estimated and its value for *Labeo niloticus* was 32.0 cm in total length. The length at recruitment (L_r) was found to be equal to 14.0 cm in total length. The length at first capture (32.0 cm) is equal to the length at first sexual maturity of females (32.0 cm). Therefore, increasing age at first capture by developing different fishing gears is recommended to regulate *Labeo niloticus* fisheries rather than restricting fishing effort which have a drastic effect on the fishermen. Also, the present level of exploitation rate should be decreased for *Labeo niloticus* to maintain a sufficient spawning biomass for recruitment. Besides, it would be economically important to protect the fish until their second year of life, after which they would have reached a good marketable size and would have performed at least one spawning activity.

Pauly and Munro (1984) have indicated a method to compare the growth performance of various stocks by computing growth performance index (ϕ). The obtained results indicated that the growth performance index (ϕ) of *Labeo niloticus* was found to be 3.277. The growth performance index (ϕ) of *Labeo niloticus* is the best in comparison with other localities (Table 6). The variations in population parameters of *Labeo niloticus* in different areas can be due to different conditions of food and temperature prevailing in these areas (Bruton, 1990). Water temperature can affect fish growth directly by affecting the physiology of the fish (Weatherley and Gills, 1987).

From the present study it can be concluded that *Labeo niloticus* stock suffers from overfishing and for a successful and practical management policy of *Labeo niloticus* in the Nile, the following strategy should be adopted:

(1) Prohibiting the catch of small size fish (less than 30 cm in total length or 266.3 gm in total weight)
(2) Preventing illegal gears with minimum mesh-size, which are still used in the River Nile.
(3) The number of boats and fishermen need to be re-evaluated on scientific base to protect and develop the Nile fishery.

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دراسة العمر والنمو وبعض نواحى ديناميكا الجماعات لأسماك اللبيس النيلى من نهر النيل عند القناطر الخيرية فى جمهورية مصر العربية

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الملخص العربـــى

أجريت هذه الدراسة لتقديم معلومات عن أحد الأسماك التجارية الهامة فى نهر النيل بهدف إستخدامها فى تحسين إنتاج هذه الأسماك من مصادرها الطبيعية وكذلك إستخدامها فى محاولة إستزراع هذه الأسماك. تتضمن الدراسة بعض الدراسات البيولوجية وديناميكا التجماعات لسمكة اللبيس النيلى من المجرى الرئيسى لنهر النيل عند القناطر الخيرية حيث تم دراسة العلاقة بين الطول والوزن وكذلك دراسة معامل الحالة وتحديد العمر. ووجد أن المعادلة اللوغاريتمية التى تربط بين وزن السمكة (وبالجرام) والطول (ل بالسنتيميتر) كالآتى: لو و = – 2.27765 + 3.18395 لو (ل). كذلك وجد أن المتوسط السنوى لمعامل الحالة (ك) = 1.03. وقد تم تحديد العمر وحساب معدل النمو بإستخدام الحلقات السنوية التى تتكون على قشور الأسماك. تم تقدير طبيعة ونوع العلاقة بين الطول الكلى لجسم السمكة وقطر القشرة. وقد وجد أن فترة الحياه لهذا النوع من الأسماك تصل إلى ست سنوات. وقد أمكن دراسةالنمو المحسوب فى الطول والوزن وأيضا العلاقة بينهما، كذلك تم حساب معدلات الوفاة ومعدلات البقاء. وتم إستنباط معادلة النمو لفون برتلانفى كالآتى : ل ت = 72.99 (1 – أ$^{-0.355\,(\text{ت} + 0.1789)}$)، ووجد أن أعلى نسبة للنمو فى الطول كانت فى السنة الأولى وكذلك تم حساب ل$_{\infty}$ والتى تساوى 72.99 سنتيميتر. وقد أثبتت الدراسة أن النفوق الكلى للأسماك فى القطيع يحدث بمعدل 73% سنويا بينما وجد أن معامل النفوق الطبيعى فى القطيع هو 0.64 وأن معامل النفوق الناتج عن الصيد هو 0.66 وبناء عليه فإن معدل الإستغلال للمخزون هو 0.51. كما وجد أن حجم السمكة عند بداية النضج الجنسى (30 سم طول كلى). كما تم دراسة أقصى طول يمكن للسمكة أن تصل إليه. وهذه النتائج تشير إلى أن عشائر أسماك اللبيس النيلى تعانى من الصيد الجائر. ولذلك يوصى البحث بعدم صيد أسماك اللبيس النيلى التى حجمها أقل من 30 سم طول كلى أو 266.3 جم وزن كلى وذلك لإتاحة الفرصة لهذه الأسماك الناضجة جنسياً أن تتكاثر على الأقل مره واحدة لتجديد المخزون.