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ON THE GROWTH OF OREOCHROMIS AUREUS (STEIN.) IN LAKE MANZALAH, EGYPT.

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ABSTRACT

Growth rate of O. aureus at three different ecological zones, El-Gamil, El-Ginkah and Middle of Lake Manzalah has been studied. The rate of growth at the early years of life was higher at El-Gamil and El-Ginkah zones than that at the Middle zone. The growth of older fish in the Middle zone has proceeded the other two zones. The Rosa Lee phenomenon was clearly observed at El-Gamil and El-Ginkah zones, while it was rather reversed in the Middle zone. The growth of O. aureus at Lake Manzalah was best described by von Bertalanffy exponential growth equation. The derived equations were as follow:

El-Gamil	Male	$Lt = 281.05(1-e^{-0.2111\ (t+0.0564)})$
	Female	$Lt = 193.75(1-e^{-0.3985\ (t-0.0185)})$
El-Ginkah	Male	$Lt = 193.03\ (1-e^{-0.4099\ (t-0.0890)})$
	Female	$Lt = 219.17\ (1-e^{-0.2872\ (t+0.0041)})$
Middle	Male	$Lt = 343.98\ (1-e)-0.166(t-0.0827)^{-0.1748\ (t+0.1069)}$
	Female	$Lt = 301.76\ (1-e)$

The weight growth curves indicated an intensive growth up to the third year of life. Beyond this age, the growth was inflected in all zones except the Middle zone. The above deduction has been indicated by organic growth equation. The growth rate of O. aureus population in Lake Manzalah has decreased considerably than in previous years.

INTRODUCTION

Lake Manzalah is considered to be one of the largest Egyptian lakes (1.5×10^5 hectare). The fishery statistics revealed ascending tendency of the total fish catch as a result of progressive increase of cichlids catch, which amounted 2.4×10^4 tons annually. The catch of Oreochromis aureus comprises approximately 50 % of the cichlid fish.

The study of the biology of cichlid fishes in different localities have been mentioned early (El-Zarka, 1958, 1961 & 1962; Jensen, 1957; Lowe, 1958; El-Bolock and Koura, 1960 & 1961 and Saclauso, 1985). However the biology of O. aureus did not receive much attention except a few investigations have been issued by Bishara, 1973 and Chehab, 1987 at Lake Manzalah.

The object of the present study is directed to study the growth of O. aureus in three different ecological zones in Lake Manzalah which may help the fishery management.

MATERIAL AND METHODS

The material of the study is Orechromis aureus (Stein.) collected from three different zones (El-Gamil; receives marine water, El-Ginkah; polluted and the Middle zone-Blank) in Lake Manzalah. The characters of these three hebitats have been decscribed before (Dowidar and Abd-El-Moati, 1983; Dowidar and Hamza, 1983 and Abdel-Baky, 1989).

A total number of 3955 fish were sampled from the three mentioned localities during 1986-1988 at monthly intervals, for age and growth analysis. Growth of length was determined from scales using Lee's formula (1920): $Ln = Sn/S (L-a) + a$, where L, is the total fish length at capture; Ln, length of fish at n years ; S, is the total scale raduis; Sn, is the raduis of annulus at n years and a, is the correction factor (intersect) derived from the linear equation of the type: $L = a + bS$, where L is the total fish length, S is the scale raduis and a and b are constants.

The data were treated for each sex separately at each of the studied zones. T-test was applied to compare the growth of both sexes in each zone during the course of life years and between the three different zones. Further the coefficient of variations, (% V= s/m x 100 where s is the standard deviation and m is the arithmatic mean) and annual increase were evaluated.

The Von Bertalanffy's growth equation :

$$Lt = L_{\infty}(1-e^{-K(t-to)}),$$

was fitted to the length at age data determined by the scale method as described in Ricker (1975).

where Lt = length at age t;
L_{∞} = asymptotic length of fish (maximum length),
e = base of the natural logarithm,
k = growth coefficient
t = age of the fish
to = a parameter indicating the hypothetical time at which the fish would have been of zero size.

The theoritical weight growth equation of von Bertalanffy was fitted to the weight at age data computed from the back calculated length as follows :

$$Wt = W_{\infty}(1 - e^{-k\,(t-to)})$$

and rearranged as :

$$Wt^{1/b} = W_{\infty}^{1/b}\,(1 - e^{-k\,(t - to)}).$$

where W_{∞} is theoritical maximum weight corresponding to L_{∞}, and b, is the exponent of the dependence of weight upon length of O. aureus at the three studied zones.

The statistical procedures applied in this context are according to Gulland (1969) and Ricker (1975).

RESULTS

- Length Structure :

1-1. El-Gamil zone :

Length groups structure curves of O. aureus population showed a slight shift from winter to summer in the age group (Fig. 1). In autumn the mode shifted to the left side. Other peaks occurred in winter and autumn seasons as well as in the pooled data. This may be denoted the age group II. However, these two peaks comprised a considerable lower composition (i.e 11 % & 7 %) for winter and autumn respectively. Age groups beyond these two age groups could not be recognized and this is probably due to the lower number of large caughted fish.

1-2. El-Ginkah zone :

As shown in Fig. 2 there is only one mode normally distributed in most of the seasons. However, in autumn two peaks occurred. It should be emphasized two age groups. The age group I lies between 9 and 11 cm and the age group II ranges between 13 and 15 cm. The shift of the curve is not discernible from one season to another.

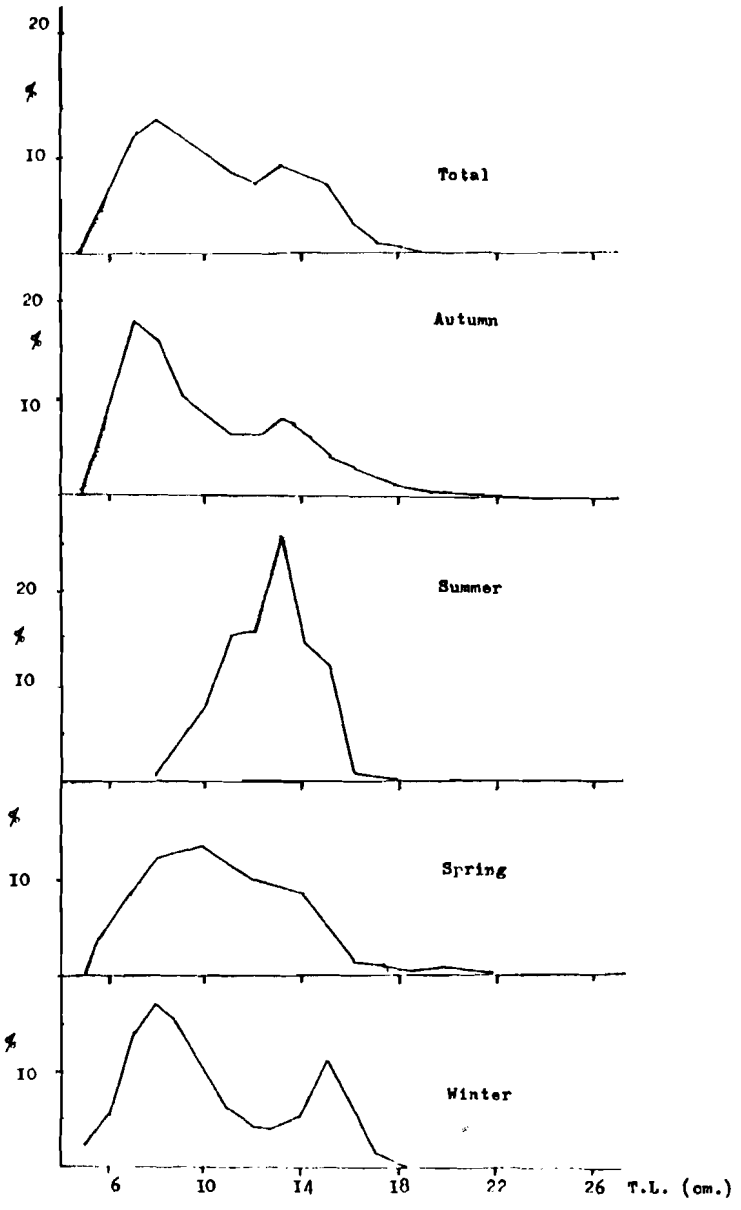

Fig. 1.

Length frequency distribution of O. aureus in El-Gamil locality of Lake Manzalah (1986-1988).

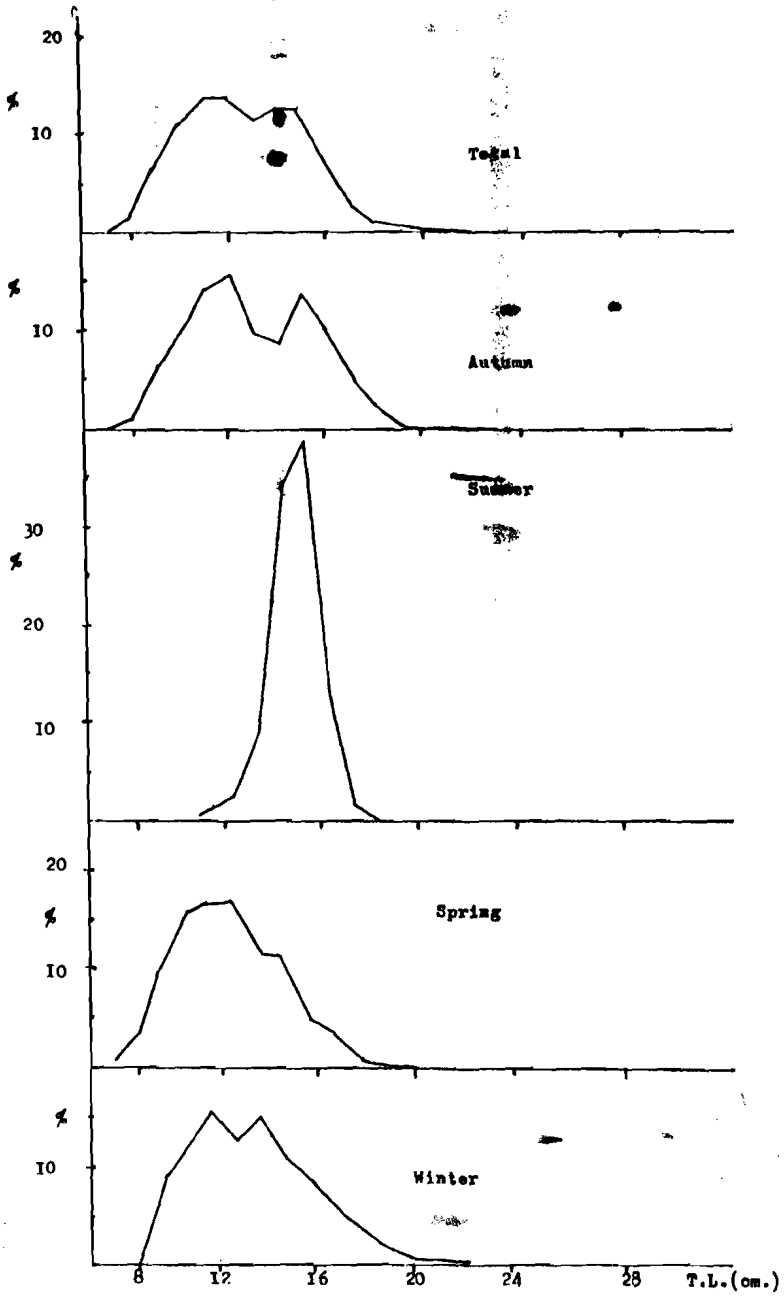

Fig. 2.

Length frequency distribution of O. aureus in El-Ginkah zone of Lake Manzalah (1968-1988).

1-3. The Middle zone :

As observed from Fig. 3, the same results mentioned above are also clearly evident in this region. Nevertheless another lower peak, could be noticed in spring season.

2- Time of Annulus Formation :

The percentage composition of fishes having scales with marginal rings in the three studied localities is presented in Table 1. It is clear that more than 50 % of the scales with marginal rings are formed during winter season. This indicates that the formation of annulus of O. aureus coincides with cold season and one ring is formed per year. This validates the ageing structure employed in the presnt study.

3- Length - Scale Relationship :

The validity of growth calculations from scale measurements requires the establishment of a relationship between the growth of the scale and that of the body. The total body length-scale radius relationship equations were found to be :

El-Gamil zone		
Male	L = 1.7686 + 58.0913 S	
	r = 0.9875 , p > 99.9 %	
Female	L = 5.6025 + 56.9316 S	
	r = 0.9727 , r > 99.9 %	
El-Ginkah zone		
Male	L = 4.5929 + 55.0186 S	
	r = 0.9873 , p > 99.9 %	
Female	L = 5.6828 + 54.982 S	
	r = 0.9933 , p > 99.9 %	
Middle zone		
Male	L = 2.4827 + 56.5018 S	
	r = 0.9877 , p > 99.9 %	
Female	L = 15.6359 + 48.7993 S	
	r = 0.9746 , p > 99.9 %	

From the above linear equations it could be concluded that the total body length - scale radius relationship is highly interdependent.

4- Growth of Length

4-1. El-Gamil zone :

It is obvious from Table 2, that the t-test has proved insignificant differences between sexes for their observed length values. Comparing the average calculated length, between sexes at successive years of life indicated a higher statistical significant values for females than males at the first two years of life. Insignificant differences have been observed in the following last years. The highest annual growth rate has been noted during the first two years of life (i.e. 100 %, 68.73 % and 100 %, 62.4 % annual increase for males and females respectively). Then the rate of growth declined considerably during the last three years.

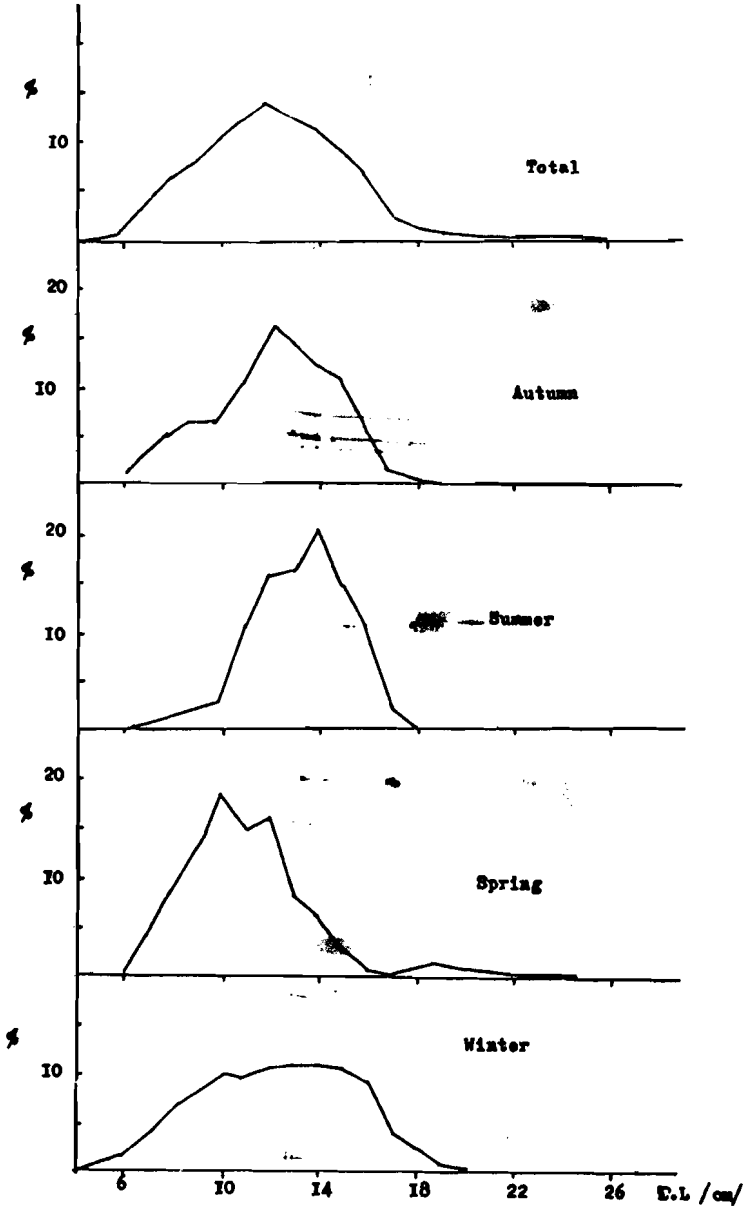

Fig. 3.

Length frequency distribution of O. aureus in the Middle zone of Lake Manzalah (1968-1988).

Table 1.

Percentage of O. aureus fishes having scales with annual rings laid on margin in Lake Manzalah (1986-1988).

Month	El-Ginkah	Middle	El-Gamil
January	6.25	17.71	1.18
February	26.04	32.29	36.47
March	16.67	10.42	2.35
April	3.13	16.67	2.35
May	1.04	-	2.35
June	-	-	-
July	-	-	-
August	3.13	3.13	-
September	2.08	2.08	-
October	10.42	-	1.18
November	6.25	2.08	-
December	[illegible]	15.63	18.82

The growth variability relative to different age groups showed a marked variation. The younger age groups revealed higher variabilities than the older ones. The same criterion was also clearly seen in the successive years of life. The pattern of growth reflects to a great textent the Rosa Lee phenomenon. The rate of annual increase of males was relatively higher than that of females.

4-2. El-Ginkah zone :

As shown in Table 3, the grand average observed length of males was significantly higher than that of females. The growth rate at the end of each year of life, revealed a higher significant growth of males than that of females, during the whole years of life except the first year, in which insignificant difference was observed. The annual growth increase in both sexes was rather identical and its pattern concordant with that of El-Gamil zone. The variabilities of the growth rate of O. aureus during the course of life were quite different. The first two years of life recorded the highest growth variabilities and then decreased progressively. The Lee phenomenon is also quite visible in various age groups. However the age group I had slightly lower variation coeffigient than age groups II and III.

Table 2.

The back calculated lengths at the end of each year of life of O. aureus in El-Gamil zone of Lake Manzalah (1986-1988).

Age groups	Sex	Back calculated lengths (mm) at the end of each year of life							
		Mean observed length(mm)	%V	L1	L2	L3	L4	L5	Fish No.
I	Male	110.00	24.90	71.59					57
	Female	110.00	24.90	78.93					78
II	Male	130.00	25.51	54.81	107.01				68
	Female	125.00	24.22	56.73	106.49				86
III	Male	150.00	18.26	50.19	92.71	138.19			30
	Female	151.00	15.96	53.48	100.71	140.21			47
IV	Male	172.00	11.18	39.96	56.33	115.80	147.45		5
	Female	167.00	12.94	45.37	86.71	124.19	153.33		11
V	Male	215.00	3.29	49.15	86.17	117.27	161.69	189.83	2
	Female	-	-	-	-	-	-	-	-
		: +:		+ ++	+ :+	: :+	: ++		
	M	129.01		59.33	100.11	134.03	151.52	189.83	
	%V	14.70		16.02	11.94	6.51	4.09	-	
Male									
	%inc.			100.00	68.73	33.88	13.05	25.28	
	NO	162		162	105	37	7	2	
Grand average		: +:		+ +:	+ ++	: ++	: ++		
	M	127.31		63.28	103.09	137.17	153.33		
	%V	13.73		18.67	5.26	4.62	-		
Female									
	%inc.			100.00	62.91	33.06	11.78		
	NO	222		222	144	58	11		

+ - Mean length values (mm), statistically significant at 0.05 probability
- Mean length values (mm), statistically insignificant at 0.05 probability.
%V- Variation coefficient, %inc.- Percentage annual length increment.

Table 3.

The back calculated lengths at the end of each year of life of O. aureus in El-Ginka zone of Manzalah Lake (1986-1988).

Age groups	Sex	Back calculated lengths (mm) at the end of each year of life						
		Mean observed length(mm)	%V	L1	L2	L3	L4	L5	Fish No.
I	Male	110.00	19.64	75.38					50
	Female	105.00	17.82	77.20					51
II	Male	140.00	23.69	64.33	119.27				98
	Female	125.00	24.22	58.54	110.25				94
III	Male	150.00	22.11	51.25	92.90	136.45			160
	Female	150.00	22.11	51.18	92.29	132.50			94
IV	Male	180.00	18.46	47.29	87.94	122.21	165.91		59
	Female	160.00	17.12	45.77	83.40	116.32	148.89		64
V	Male	170.00	8.32	40.84	70.59	105.42	131.54	161.29	2
	Female	175.00	10.69	39.28	74.22	105.79	136.70	168.28	4
Grand average	Male	M	146.83		57.30	99.94	132.37	164.78	161.29
		%V	14.68		16.65	13.13	5.15	3.75	-
		%inc			100.00	74.42	32.45	24.48	-
		NO	369		369	319	221	61	2
	Female	M	137.28		56.47	96.38	125.45	148.17	168.28
		%V	14.50		18.52	11.70	6.75	1.95	-
		%inc			100.00	70.67	30.16	18.11	13.57
		NO	307		307	256	162	68	4

4-3. Middle zone :

As conspicuous from Table 4, the average observed length of males was significantly higher than that of females. During the first year of life growth rate of females was markedly higher than that of males. In the second year growth of length did not show significant differences. Beyand the second year of life male growth was considerably greater than female's. The pattern of annual increment of O. aureus was analogous to that occurred in the above zones i.e., older age groups had higher growth rate than the younger ones.

Regarding the comparison of growth in length of O. aureus in the three zones, it could be mentioned that the average observed length of O. aureus at El-Ginkah zone recorded the highest significant value for both sexes. Insignificant difference has been observed between El-Gamil and the Middle zones. However, the maximum coefficient of variation was recorded for males at the Middle zone (18.6 %). During the first year of life growth of length of males at El-Gamil zone was significantly higher than that at the other two zones. The second and the third years of life did not indicate significant differences between growth of males at El-Gamil and El-Ginkah zones, while a lower significant growth was evident in the Middle zone. The last two years of life proved a highly considerable significant growth for males at the Middle zone. The growth rate of females at El-Gamil zone showed a significant higher values during the whole years of life in El-Ginkah zone except the first year. The female growth of O. aureus at the Middle zone recorded the lowest significant values up to fourth year of life. Beyond this age a sudden elevation of growth was observed.

5- Von Bertalanffy's Growth Curves :

The parameters of the exponential growth equation for both sexes at different zones are presented in Table 5. The maximum lengths were calculated as 343.98 mm and 301.76 mm for males and females respectively at the Middle zone, while the minimum asymptotic length was determined as 193.03 for males of El-Ginkah zone.

For convenient comparison of length growth of O. aureus population at different zones of Lake Manzalah the Von Bertalanffy's growth equation is well documented. As presented in Table 5, the asymptotic length (L_{∞}) was greatly high at the Middle zone. The lowest maximum length was observed for males at El-Ginkah zone, while the females recorded asymptotic length slightly higher than that at El-Gamil zone. However, the growth coefficient (K) showed a reverse trend to the asymptotic length, i.e. low in the Middle (K = 0.166 & 0.1748 for males and females respectively) and high at El-Gamil zone (K = 0.4099 for males and 0.2372 for females). The above phenomenon is quite visible where highest annual growth increase was noticed at the Middle zone and the lowest one at El-Ginkah zone.

Table 4

The back calculated lengths at the end of each year of life of O. aureus in the Middle zone of Lake Manzalah (1986-1988).

Age groups	Sex	Back calculated lengths (mm) at the end of each year of life							
		Mean observed length(mm)	%V	L1	L2	L3	L4	L5	Fish NO.
I	Male	105.00	2.33	58.99					69
	Female	110.00	19.64	80.01					52
II	Male	120.00	27.63	56.12	105.67				114
	Female	125.00	10.33	66.91	112.65				74
III	Male	140.00	23.69	43.02	83.61	124.29			129
	Female	135.00	18.14	53.28	86.60	121.73			97
IV	Male	186.25	23.65	47.31	89.31	131.93	171.99		37
	Female	145.00	8.90	46.13	77.37	105.16	135.16		20
V	Male	205.00	15.17	37.18	85.35	124.57	162.80	190.11	6
	Female	190.00	-	47.34	85.38	142.45	180.49	190.00	1
Grand average Male	M	132.69		50.68	93.18	125.94	170.71	190.11	
	%V	18.60		13.76	11.11	2.50	1.89	-	
	inc.			100.00	83.86	35.16	35.55	11.36	
	NO	355		355	286	172	43	6	
Female	M	127.68		62.50	95.67	119.10	137.32	190.00	
	%V	8.97		18.13	14.37	5.54	7.20	-	
	inc.			100.00	53.07	24.49	15.30	38.36	
	NO	244		244	192	118	21	1	

Table 5.

The Von Bertalanffy's growth parameters of
O. aureus population in Lake Manzalah (1986-1988).

Zone	Sex	NO	L_∞ (mm)	W_∞ (gm)	K	to	r	%p
El-Gamil	Male	162	281.05	323.44	0.2111	-0.0564	0.9674	>99.9
	Female	222	193.75	104.20	0.3985	0.0185	0.9931	>99.9
El-Ginkah	Male	369	193.03	107.59	0.4099	0.0890	0.9568	>99.9
	Female	307	219.17	164.40	0.2872	-0.0041	0.9985	>99.9
Middle	Male	355	343.98	621.11	0.1660	0.0827	0.9833	>99.9
	Female	244	301.76	424.10	0.1748	-0.1069	0.8800	>99.9

r - Coefficient of correlation, significant at 0.05 probability.
%p - Percentage point of probability.

6- Growth of Weight :

The grand average growth of weight, annual increment and the coefficient of variation (V), for O. aureus in three different zone of Lake Manzalah are presented in Table 6. It is evident that there was an intensive growth in weight up to the third year of life in case of both sexes at the three studied localities. After that a decline in the growth increment was noticed at El-Gamil zone. The unexpected elevation in the growth increment at the fourth year of life for males at this zone probably due to the lower number of the old indivaduals which can not reflect its virtual growth.

At El-Ginkah zone the growth proceeds slowly beyond the third year of life for both sexes. In the Middle zone the growth enhanced beyond the third year of life in case of males (increment = 47.78 gm), then it slowed down. On the other hand the growth of females at this zone showed unexpected increase beyond the fourth year of life which can not represent the true population growth (only one fish was sampled).

The coefficient of variation of growth of weight during the course of life resembles to much extent that of length.

Table 6.

Grand average calculated weight at different years of life for O. aureus, in three different zones of Lake Manzah (1986-1988).

Zone	Item	Weight at the end of each year (gm)									
		W_1		W_2		W_3		W_4		W_5	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
		+	+	+	+	:	:	:	:		
	M	3.34	4.23	15.37	16.25	35.84	37.73	51.58	52.11	100.11	- -
El-Gamil	Inc.	3.34	4.23	12.03	12.02	20.47	21.48	15.73	14.38	48.53	- -
	%V	47.23	54.00	26.79	14.00	17.36	12.62	13.84	-	-	- -
	N	162	222	105	144	37	58	7	11	2	- -
		:	:	+	+	+	+	+	+		
	M	3.20	2.97	16.11	14.13	35.47	30.60	67.59	50.13	63.21	73.21
El-Ginkah	Inc.	3.20	2.97	12.91	11.16	19.36	16.47	32.12	19.53	-	23.08
	%V	51.88	62.59	40.77	35.13	14.20	19.66	9.07	5.49	-	
	N	369	307	319	256	221	162	61	68	2	
		+	+	+	+	+	+	+	+		
	M	1.99	3.91	12.81	13.76	31.08	25.37	78.86	39.44	109.54	103.9
Middle	Inc.	1.99	3.91	10.82	9.85	18.27	11.61	47.78	14.07	30.68	64.52
	%V	39.19	54.58	34.18	43.59	3.90	15.68	5.55	28.77	-	-
	N	355	244	286	192	172	118	43	21	6	1

M- Grand average annual weight (gm). Inc.- Grand average annual weight increase
%V- Coefficient of variation. N - Fish number
+ - The average weight between sexes is statistiolly significanot at 0.05 level of probability.
: - Denote insignificant differences at 0.05 level of probability.

The hypothetical weight growth rate of O. aureus in the three different ecological zones is presented in Table 5. The highest W_∞ was recorded in the Middle zone for both sexes (i.e. 621.11 gm and 424.1 gm for males and females respectively). However, the lowest one was recorded for females at El-Gamil (104.20 gm) and males of El-Ginkah (107.59 gm). From the hypothetical growth curves, it could be emphasized 3 sigmoid shaped curves, one for the males at El-Ginkah with an inflection occurred at the third year corresponding to 40 gm weight. The other two S shaped curves occurred in case of females at El-Ginkah and El-Gamil zones. The former has an inflection beyond the third year (50 gm). The latter has an inflection at the same age (about 40 gm in total weight). At the Middle zone, there was no inflection during the whole life.

DISCUSSION

The study of length structure of O. aureus population at the three different localities of Lake Manzalah did not prove Petersen's phenomenon, i.e. no clear modes occurred corresponding to the calculated length from scales for different age groups. The shift of the identified modes was not clearly noticeable. However, the mode was shifted to the opposite side (left side) almost in all zones at autumn. This can be probably indicates the interference of new recruitment to the fishery grounds as a result of the partial spawning of O. aureus during spring and summer seasons. This gets support from the fact that cichlids are fractional spawners. On the other hand the scarcity of large fish amongst O. aureus [redacted]ulation can be probably attributed to the mortality d[redacted] intensive exploitation and natural death caused by hi[redacted] increased eutrophication and pollution of the lake wat[redacted]Weatherly, 1972; Zawisza, et al., 1979).

Regarding the time of annulus formation, our results indicated the formation of the checks at winter season. More than 50 % of the scales with marginal rings occurred during winter (Jensen, 1957). It was very difficult to observe this value within a sharp restricted month, as there is no extremely cessation of growth. This can be interpreted from the fact that the water temperature does not fall below 14°C at winter season in subtropical waters. At this temperature the fish can continue, its feeding activity at a relatively lower rate causing a retardation of fish growth (Bilton, 1974; El-Serafy et al, 1987). Thereby the annuli were not so sharp but could be identified from their comparatively closely spaced ridges.

The total length-scale radius relationship of O. aureus in the three studied zones declared a strong linear correlations. This confirms the validity of using scales for growth assessment. The difference in the results of these equation parameters at different zones in Lake Manzalah reflects an assymetry of O. aureus scales (Goldspink, 1978).

The rate of growth of younger age groups of O. aureus at El-Gamil and El-Ginkah zones was obviously higher than that of the older ones. This may be due to the higher growth variabilities (Marciak, 1974 and Ricker, 1975). On the other hand the lower growth of the older age groups at these two zones could be attributed to the lower growth variability and migration of healthly individuals due to the environmental stress (Peczalska, 1963; Brylinska & Biatokoz 1972; Marciak, 1974; Ricker, 1975 and Zawisza et al., 1979). The variation in growth rate at different growth stanza may be due to the difference in food organisms available for each stage (stanza) of life as well as the nature of environment (Vasnetsov, 1953; Marciak, 1974).

In the Middle zone the growth of young fishes was generally slower than the fishes of the other zones. This gets support from Dowidar and Abd-El-Moati (1983), and Dowidar and Hmaza (1983). They observed that the biomass and productivity at El-Ginkah water was higher than that of the other zones. On the other hand, marked elevation of growth for the old fishes im the Middle zone could be attributed probably to selective fishing.

Comparing our results with the available literature cited by Bishara, (1973) and Chehab, (1987), as shown in Table 7, it can be stated that a decline trend in the growth rate of O. aureus population is evident. The sharp decline in the present results could be referred to the consecutive increase of eutrophication and pollution of the Lake water and this is the mainly causative factor. Many authors attributed the slow growth particularly in eutrophic lakes to the excessive dense of population of fish recruits and disappearance of predacious fish (Hofseted, 1974; Bager, 1978; Wyatt, 1988 and Abdel-Baky, 1989).

The growth of O. aureus at Lake Manzalah is best described by Von Bertalanffy's exponential model. The results declared a higher growth at the Middle zone. However, the great value of asympotitic length (i.e., L_∞ = 343.98 mm and 301.76 mm for males and females respectively) did not actually represent the real pattern of growth, as the sampled fishes were very few which entailed this marked elevation. Generally speaking, the maximum estimated lengths at the other two zones were less than those recorded at Lake Manzalah in the previous years. Bishara, (1973), reported an asymptotic length as 280 and 260 mm for males and females respectively, while Chehab, (1987), recorded it as 280.33 mm at the Middle, 240.93 mm at El-Gamil and 270.60 at El-Ginkah zones. Under the mentioned circumstances it could be pointed out that the growth of O. aureus in Lake Manzalah is steepened.

The growth coefficient K, was found to be ranged from 0.2111 to 0.4099 at El-Gamil and El-Ginkah zones. Chehab, (1987), recorded it as 0.2620 at El-Ginkah and 0.3456 at El-Gamil. It is known that as the value of K increases the growth rate decreases (i.e. there is a reverse correlation).

Table 7.

Growth rate O. aureus in Manzalah Lake according to different authors.

Author	Sex	Length (mm) at the end of time (year) L1	L2	L3	L4	L5
Bishara (1973)	Male	97.00	169.00	212.00	-	-
	Female	86.00	153.00	189.00	-	-
Chehab (1987)	Combined sex	74.59 (235)	11.39 (158)	154.12 (44)	196.75 (16)	216.34 (7)
Present Data:						
El-Gamil zone	Male	59.33 (162)	110.11 (105)	134.03 (37)	151.52 (7)	189.83 (2)
	Female	63.28 (222)	103.09 (144)	137.17 (58)	153.33 (11)	-
El-Ginkah zone	Male	57.30 (369)	99.94 (319)	132.37 (221)	164.78 (61)	161.29 (2)
	Female	56.47 (307)	96.38 (256)	125.25 (162)	148.47 (68)	168.28 (4)
Middle zone	Male	50.68 (355)	93.18 (286)	125.94 (172)	170.71 (43)	190.11 (6)
	Female	62.50 (244)	95.67 (192)	119.10 (118)	137.32 (21)	190.00 (1)

Number of fishes is between brackets

The slightly lower value of K in our study at El-Gamil zone could be attributed to the difference in the sample size, since our sample size was considerably greater than Chehab's, (1987).

The growth in weight fitted by Von Bertalanffy theoretical equation has been deduced three sigmoid curves. At El-Ginkah and El-Gamil zones, the inflection of the growth curves was found to correspond almost the third year of life. At this age the fishes ranged in weights between 40 and 50 gm. However, no inflection was evident for the fish at the Middle zone during the whole life, caused substantially by the highly growing few old individuals which do not reflect the real growth of fish at that age. It is well documented that the S. shaped curve is originated mostly amongst long life fishes characterized by slower growth rate (Ricker, 1975). From the above it could be

concluded that the growth of O. aureus at Lake Manzalah agrees with the above assumption, as a result of the progressive changes in ecological condition of the Lake.

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