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ECOLOGICAL AND FISHERIES MANAGEMENTOF EDKU LAKE

7. ABUNDANCE AND DISTRIBUTION OF FISH POPULATIONS AT EDKU LAKE DURING THE YEAR 2000

BY

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ABSTRACT

Experimental fishing operations were carried out at Edku lake during the period from November 1999 to March 2001. Six fishing areas were selected in a way that they can represent the whole area of the lake. Monofilament nylon trammel nets with different mesh sizes ranging from 3.33 cm to 6.85 cm stretched measure were used during the present investigation.

The present study was carried out with the aim of investigating the abundance and distribution of the various fish species in the different areas of the lake.

It was found that Oreochromis niloticus dominated the experimental catch comprising 41.82% by weight of the whole catch. The other Cichlid fish species namely Oreochromis aureus, Tilapia Zillii and Sarotherodon galilaeus formed 23.61%, 14.33% and 7.37% respectively of the catch.

The fresh water cat fishes Clarias lazera and Bagrus bayad formed 7.21% and 5.45% of this catch.

The average lengths of fish caught from the lake were found to be:

13.03cm	*for*	*O. niloticus*	
12.74cm	*for*	*O. aureus*	
10.96cm	*for*	*T. zillii*	*and*
14.62cm	*for*	*S. galilaeus*	

It was possible to indicate that these four species were mainly caught from the lake during their second or third year of life.

The average lengths of ***C. lazera*** *and* ***B. bayad*** *were found to be 30.55cm and 23.79cm in respective.*

A comparison between the participation of the marine fish species in the experimental catch taken from Edku lake during the years 1990 and 2000 showed that these species contributed by 28.76% by weight during 1990 while it decreased

drastically to 0.42% only during the year 2000. Such decrease may be attributed to pollution of the lake water, fishing of fish fry with large number for stocking the fish farms as well as the unfavorable conditions of the lake-sea connection that can affect the movement of fry to the lake.

INTRODUCTION

Edku lake, as it is the case in the other north delta lakes in Egypt, faced in the last 20 years many problems which inversely affected the yearly fish production of these lakes.

One of the most serious problems which faced Edku lake during the last years is the discharge of high rates of drainage water which transplanted annually to the lake high amounts of agricultural, industrial as well as domestic wastes. Such drainage water discharge which usually takes its way through the lake to the sea decreased the salinity of the lake water specially at the area of the lake near the lake-sea connection.

Although the average value of salinity in this area was found to be around 21.5 parts per thousand since 20 years, this average decreased to 2.52 parts per thousand during the year 2000. (Abbas *et al* 2001). Such decrease gives us an impression that sharp and drastic environmental changes were occurring at the lake during the last 10 years.

The fish populations at Edku lake as well as the other delta lakes are generally comprised from fresh water fish species, mainly Tilapias as well as those species of marine origin. The marine fish species enter the northern delta lakes as fry through the lake - sea connections. The migration of these marine species to the brackish water of the lakes comes with the aim for feeding. Such species live well and grow in the lake water as far as the environmental conditions are optimum for their survival. At the time they reach their sexual maturity they return back to the sea for reproduction.

In fact both the fresh water fish species living at the lake and those species of marine origin are characterized by wide size ranges belonging to different age groups.

The distribution of fish populations in the lake is affected mainly by the environmental conditions specially the hydrochemical characters of the water as well as its hydrobiological conditions.

It is believed therefore that the high rates of water discharge in Edku lake during the last ten years could drastically affect the marine life, as well as the abundance and distribution of fish in this lake, specially those species of marine origin which are more sensitive to the ecological conditions.

However it is aimed in the present study to investigate the seasonal geographic distribution of the various fish populations in the lake in relation to the ecological conditions prevailing at this lake during the year 2000.

Experimental fishing operations were carried out at the different parts of the lake using trammel nets having a wide range of mesh sizes. These nets were able therefore to catch the various sizes of fresh water and marine fish species.

The present study is a part of the research plan of the fisheries division, National Institute of Oceanography and Fisheries in Egypt. This plan aims to develop the fisheries at the northern delta lakes namely Manzalah, Borollus, Edku and Mariut.

Edku lake

Edku lake is situated at about 30km to the north east of Alexandria has an area of about 17.000 feddans and a water depth ranging from 0.50 to 1.50m with an average of 0.75m.

The inflow of water for Edku lakes is provided mainly from the drainage water discharged through Barsik and El-Khairy drains. Before discharging in the lake El-Khairy drain is connected with three subdrains namely Edku, Damanhour and El-Bosily subdrains. It is believed that the drainage water of Edku subdrains is composed mainly from agriculture wastes, while the drainage water of El-Bosily subdrain is comprise mainly from domestic as well as industrial wastes.

The inflow of Damanhour subdrain is in fact a mixture from domestic, agricultural and industrial wastes. In addition to the drainage water, Edku lake receives sea water from the Meditenanrian through the lake sea connection at the north western part of the lake. This inflow occurs mostly during winter. El-Samra (1973) pointed out that the chlorosity of the surface water of El-Tawila island in winter reached 2.3gm Cl/L. He was able to detect the extension of mixed marine water into the lake up to this area during winter.

Some years back Edku lake was classified among oligotrophic lakes (Salah, 1960, 1961 and Soliman 1983). Due to the high inputs of nutrient rich effluents at its eastern and southern sections the lake became hypertrophied (Crharib, 1998).

Experimental fishing techniques through out the present investigation:

Trammel net is considered as the most common fishing gear used in the north delta lakes of Egypt. This net is used to catch all fish species living in thee lakes. Nets with a narrow meshed inner layers are used to catch those species of marine origin while others having wider meshes are used to catch Tilapias. Typically the lead rope of trammel net is longer than the cork rope, so that the pockets are more easily formed. (Alsayes, 1976).

Experimental fishing survey was carried out at Edku lake during the period from Nov. 1999 to March 2001. Six localities were selected in the lake for carrying the experiments covering the whole area of the lake as shown in Fig. (1).

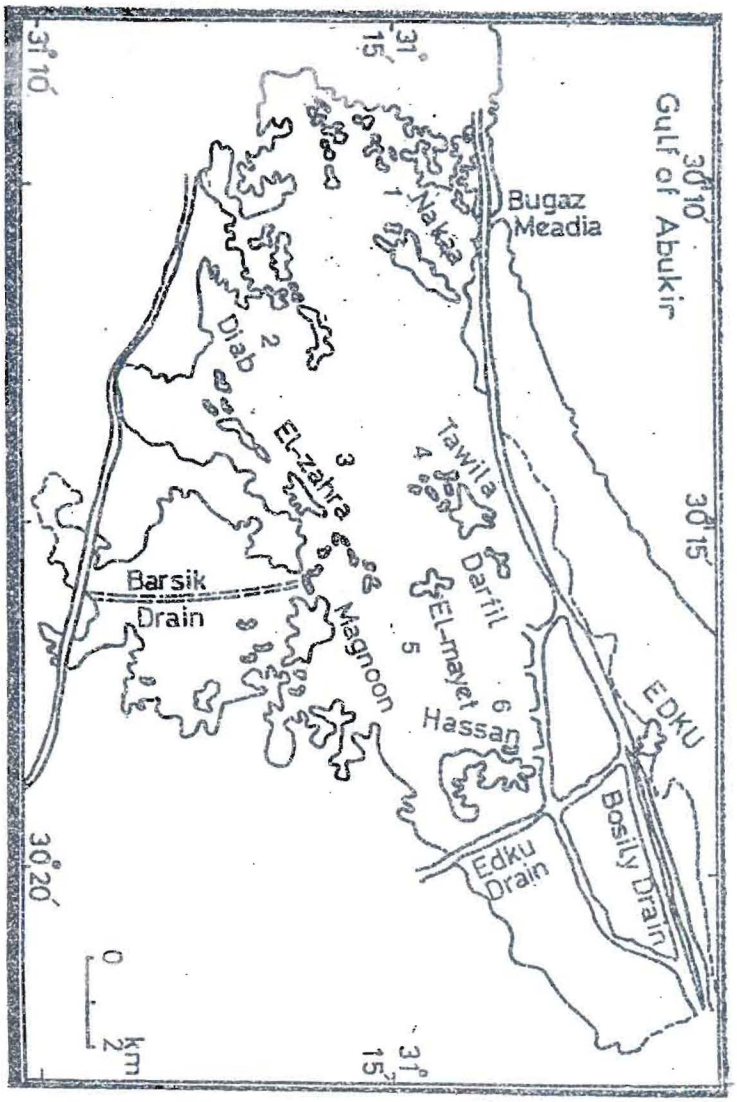


Fig.(1): The location map of sampling stations in Lake Edku.

Trammel nets with different mesh sizes were used in the present survey to overcome any problem that may result from the species or size selection while sampling the fish populations. The stretched mesh sizes of the inner layers of the five nets used were 3.33, 3.85, 4.35, 5.04 and 6.85cm. The mesh size of the outer layers of these nets were 10.45, 12.24, 13.51, 15.85 and 21.33cm.

It appears therefore that the sampling of the fish populations at the different areas of the lake was carried out in a way that all of the individuals comprising these populations were having equal chances to be members of the experimental catch.

RESULTS AND DISCUSSION

Fishing with trammel net depend upon the movement of fish and therefore the catch per unit effort is a function of the activity of fish in the vicinity of the nets as well as their abundance in the area of fishing.

The experimental catch taken by various mesh sizes of trammel net from different areas of the lake can therefore be considered as a good measure for the seasonal as well as geographic distribution of the fish populations in this lake.

A. Seasonal species composition of the fish population at Edku lake

The species composition of the catch taken by trammel net during the period from Nov. 1999 to Nov. 2000 is given in table (1) and is graphically represented in Fig. (2).

It can be pointed out from the data given in table (1) that *Oreochromis niloticus* dominated the catch comprising 41.82% by weight of the total catch during this period. This fish species constituted 49.39%, 44.51%, 28.02% and 56.38% of the catch during winter, spring, summer and autumn respectively. This indicates that *O. niloticus* becomes active and move around in the open water of the lake during autumn if compared with the other species of Tilapia.

Next to *O. niloticus* it can be observed that *Oreochromis aureus* constituted the second percentage in the catch having a value of 23.61% by weight of the total catch. It is worth mentioning that *O. aurues* constituted higher percentage than *O. niloticus* during summer. This leads us to believe that *O. aureus* can be considered as the most active and abundant fish in the lake in summer.

Tilapia zillii constituted considerably in the catch during the whole period of the year with the exception of autumn. The percentages of this fish species were 13.05%, 19.81%, 16.96% during winter, spring and summer while it dropped to 5.49% during autumn.

Table 1 : Species composition of the experimental catch taken by trammel net during the course of experiments

Species / Season	*O.niloticus*	*O.auraus*	*S.galilaeus*	*T.zillii*	*B. bayad*	*C. lazera*	*Others*	**Total**
Winter	26.180 (49..39)	5.420 (10.22)	0.415 (0.78)	6.915 (13.05)	0.780 (1.47)	13.300 (25.09)	---	53.010
Spring	34.825 (44..51)	23.150 (29.59)	2.170 (2.77)	15.500 (19.81)	1.500 (1.92)	1.100 (1.41)	---	78.245
Summer	35.690 (28.02)	42.220 (33.15)	8.140 (6.39)	21.605 (16.96)	14.825 (11.64)	4.210 (3.31)	0.670 (0.53)	127.360
Autumn	44.390 (56.38)	8.850 (11.24)	14.140 (17.96)	4.320 (5.49)	1.305 (1.67)	5.725 (7.27)	----	78.740
Total	**141.085 (41.82)**	**79.640 (23.61)**	**24.865 (7.37)**	**48.340 (14.33)**	**18.410 (5.45)**	**24.335 (7.21)**	**0.670 (0.53)**	**337.345**

Weights are expressed in kg.
% weights are given in parenthesis.

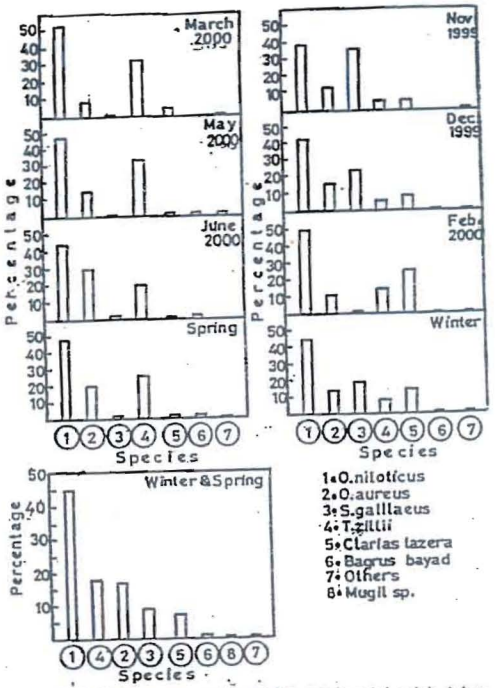


Fig.(27): Species composition of the exprimental catch taken by trammel nets from Lake Edku during winter and spring.

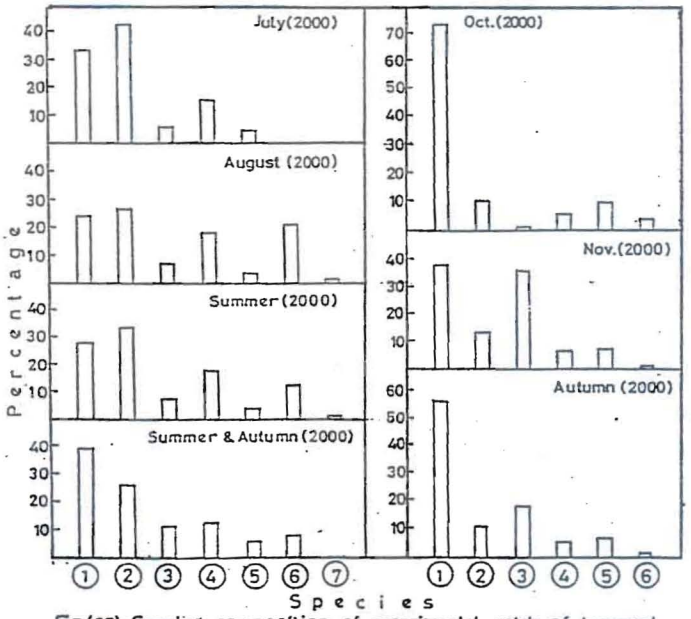


Fig.(28): Species composition of experimental catch of trammel net during Summer & Autumn.

Sarotherodon galilaeus appeared in the experimental catch with considerable contribution during autumn, on the other hand its contribution in this catch was modest through winter, spring and summer. It constituted 17.96% of the experimental catch during autumn, this constitution decreased to 0.78%, 2.77%, and 6.39% during winter, spring and summer respectively. It can be observed that such contribution increased gradually from winter to summer. The gradual increase of water temperature may by a considerable factor in this concern.

The other two fresh water fish species namely *Bagrus bayad* and *Clarias lazera* contributed in the experimental catch with percentages below those of the four Tilapia species. *Clarias lazera* comprised 7.21% during the whole period of the year while *Bagrus bayad* constituted 5.45% only of such catch.

Other fish species such as ***Liza ramada*** and *Anguilla* sp. appeared in the experimental catch with low percentages forming 0.30% and 0.12% respectively.

B. Size composition of the various species caught from Edku lake.

The size composition of fish caught from the north delta lakes has been indicated by several authors. Among these authors are El-Zarka *et al* (1970) who pointed out through their study on the biological characters of Tilapia fish in the north delta lakes that most of the Tilapia species were usually caught at an average size of 11.0cm total length.

Alsayes (1976) showed that the average length of *Tilapia zillii* experimentally caught from Borollus lake using trammel nets having various mesh sizes was 9.26cm. The average length of *Oreochromis niloticus* caught from the same lake was 12.27cm.

Alsayes and Soliman (1993) found that the average lengths of *Tilapia zillii* experimentally caught from Edku lake were 10.32cm and 12.73cm during June and November 1990 and it was 11.65cm during February 1991. The average lengths of *Oreochromis niloticus* during the same months were 16.64cm, 14.52cm and 14.60cm respectively.

The length frequency as well as the average lengths of the most common fish species experimentally caught from Edku lake during the present investigation are given in Tables 2, 3, 4, and 5.

The average lengths of the four Tilapias were found to be 13.03cm for ***O. niloticus***, 12.74cm for ***O. aureus***, 10.96 for ***Tilapia zillii*** and 14.68cm for ***S. galilaeus***.

It can be indicated from such data that the average length of ***T. zillii*** was the least between the average lengths of the four Tilapia species.

Table 3 : Seasonal length frequency distribution of *Oreochromis aureus* caught from Edku lake

Length (cm)	Number of fish				Total number of fish caught
	Autumn	Winter	Spring	Summer	
7.5		1	2		3
8.5	2	3	8	1	14
9.5	1	11	81	4	97
10.5	8	53	145	34	240
11.5	57	131	296	203	687
12.5	72	93	243	404	812
13.5	47	43	113	189	382
14.5	26	33	37	46	142
15.5	15	17	8	28	58
16.5	9	8	4	6	27
17.5	2	2	1	10	15
18.5				7	7
19.5				2	2
20.5					
21.5				2	2
Total number	239	395	938	936	2488
Average length (cm)	12.94	12.28	11.82	12.74	13.326
Standard deviation	1.535	1.593	1.374	1.395	1.492

Table 4 : Seasonal length frequency distribution of *Tilapia zillii* caught from Edku lake

Length (cm)	Number of fish				Total number of fish caught
	Autumn	Winter	Spring	Summer	
7.5		3	11	2	16
8.5		9	132	11	152
9.5	3	38	309	32	382
10.5	15	148	330	90	583
11.5	35	111	236	208	590
12.5	18	29	79	95	221
13.5	17	10	37	31	95
14.5	7	12	21	13	53
15.5	3	4	11	6	24
16.5	1		3	2	6
17.5			3		3
Total number	99	364	1172	490	2125
Average length (cm)	12.20	11.05	10.57	11.57	10.96
Standard deviation	1.425	1.282	1.513	1.300	1.508

Table 5 : Seasonal length frequency distribution of *Sarotherodon galilaeus* caught from Edku lake

Length (cm)	Number of fish				Total number of fish caught
	Autumn	Winter	Spring	Summer	
8.5		2			2
9.5		4	1		5
10.5		5	1		6
11.5	1	9	5		15
12.5	2	22			24
13.5	28	38	4	1	71
14.5	131	66	12	13	222
15.5	79	38	7	14	138
16.5	14	10	2	11	37
17.5	4	3	2	19	28
18.5			1	2	3
19.5				3	3
Total number	259	197	35	63	554
Average length (cm)	14.82	14.04	14.30	16.33	14.68
Standard deviation	0.854	1.596	1.983	1.420	1.495

Elestar *et al* (1960), and Botros (1969) found that *T. zillii* grows with lower rates in either length or weight than the other Tilapia species. They attributed this slow growth rate to the high fecundity of *T. zillii* which infers an extra burden on the fish.

It appears also from the data given that the average length of *S. galilaeus* was the highest between the Tilapia species. This may point out to the higher growth rates of both *O. niloticus* and *S. galilaeus* in comparison with the growth rates of the other two species.

In this concern, it has been indicated by El-Zarka *et al* (1970) that the calculated lengths of *Tilapia nilotica* during the ends of successive years of life at Mariut lake were as follows:

Year of life	Calculated length (cm)
I	8.37
II	21.25
III	28.72
IV	32.61
V	35.91

El-Shazly (1993) compared between the growth of the four Tilapias at Mariut lake. He pointed out that the average lengths (in cm) of these fish species at the various years of their lives were as follows:

	1st year	2nd year	3rd year	4th year
O. niloticus	8.44	14.21	18.80	24.17
O. aureus	7.88	12.72	16.34	--
T. zillii	8.15	12.24	--	--
S. galilaeus	7.89	12.25	18.45	--

Shawky (1999) carried out the same comparison at Manzalah lake and gave the following average lengths:

	1st year	2nd year	3rd year	4th year
O. niloticus	8.64	11.33	13.97	16.58
O. aureus	6.88	10.67	13.44	15.86
T. zillii	6.18	8.64	10.95	13.20
S. galilaeus	8.06	11.06	13.91	16.51

Abdalla (1995) in his comparison between these average lengths at Edku lake indicated the following values:

	1st year	2nd year	3rd year	4th year
O. niloticus	9.03	13.07	15.89	18.21
O. aureus	7.35	11.14	13.54	16.21
T. zillii	7.03	10.50	12.81	15.10
S. galilaeus	8.21	12.38	14.84	17.19

The average lengths at the various years of life for the four Tilapias indicate that the growth rate of *T. zillii* was the lowest in comparison with the other species. On the other hand *O. niloticus* and *S. galilaeus* are characterised by higher growth rates at the three north delta lakes of Egypt.

It was indicated by some authors that *O. niloticus* grows fast but is less salt-tolerant than *O. aureus* (Watanabe *et al*, 1985, Avella *et al* 1993).

It can be concluded also that these fish species are mainly caught during their second or third years of life.

The sizes of *Clarias lazera* during the course of the present investigation ranged between 17.5cm and 50.5cm (Table 6) with an average of 30.55cm. Alsayes *et al* (1992) found that *Clarias lazera* attained 18.30cm in length at the end of their first year of life. The lengths reached 28.0, 36.9 and 42.7cm during their next years of age respectively.

This can indicate that *C. lazera* is mainly caught from the lake during the second and sometimes during the third years of their ages.

Bagrus bayad was caught with sizes ranging between 14.5cm and 43.5cm with an average length of 23.79cm (Table 7). This fish was mainly caught during the summer season. It is believed that most of the fish caught moved from the drains located near to Edku lake towards the lake during the summer season when the drainage water is discharged to the lake with comparatively high rates.

			1	2	5
24.5	2	1		3	6
25.5	4	1		3	8
26.5	3		3	3	9
27.5	9	1	1	2	13
28.5	8	3	1	3	15
29.5	6	1	2	2	11
30.5	11	2		3	16
31.5	7	2	1	1	11
32.5	9	1	2	2	14
33.5	14	4	2		20
34.5	3		1	1	5
35.5		3	2		5
36.5	1				1
37.5	1	1			2
38.5	1	2			3
39.5					
40.5	2				2
45.5	4				4
50.5	1				1
Total number	90	24	17	25	156
Average length (cm)	31.28	31.00	29.91	27.94	30.55
Standard deviation	5.319	5.073	4.184	3.042	4.978

Table 7 : Seasonal length frequency distribution of *Bagrus bayad* caught from Edku lake

Length (cm)	Number of fish				Total number of fish caught
	Winter	Spring	Summer	Autumn	
14.5		1			1
15.5	1				1
16.5	1	4	1		6
17.5	3	4	5		12
18.5	6	2	6		14
19.5		1	11		12
20.5	2	1	14		17
21.5	1		16		17
22.5		1	17	2	20
23.5		1	24	2	27
24.5		1	21		22
25.5		5	21	1	27
26.5		3	10		13
27.5		1	13	1	15
28.5	1	1	5	1	8
29.5			4	1	5
30.5	1	1	6		8
31.5		1			1
32.5			2		2
33.5				1	1
34.5			1		1
35.5					
36.5					
37.5			1	1	2
38.5			1		1
40.5					
43.5			1		1
Total number	16	28	180	10	234
Average length (cm)	19.81	22.25	23.93	27.40	23.79
Standard deviation	4.078	4.926	3.504	5.021	4.320

C. Distribution of fish in the lake:

It is a matter of fact that the ecological features especially the chemical composition of the lake water, play a very important role in distributing the various fish species through the whole area of the north delta lakes of Egypt. The areas of the lake laying adjacent to the north and facing the lake sea connection is believed to be characterized by higher abundance of the marine fish species which are used to migrate for feeding from the sea to the lake.

Alsayes and Soliman (1993) in their study on the species composition of fish populations at Edku lake indicated that the various marine fish species comprised 28.76% of the whole fish population of this lake.

The species composition of the experimental catch taken from the different localities of the lake during the present study which extended for the two years 1999 and 2000 is given in table (8) and graphically represented in Fig. (3).

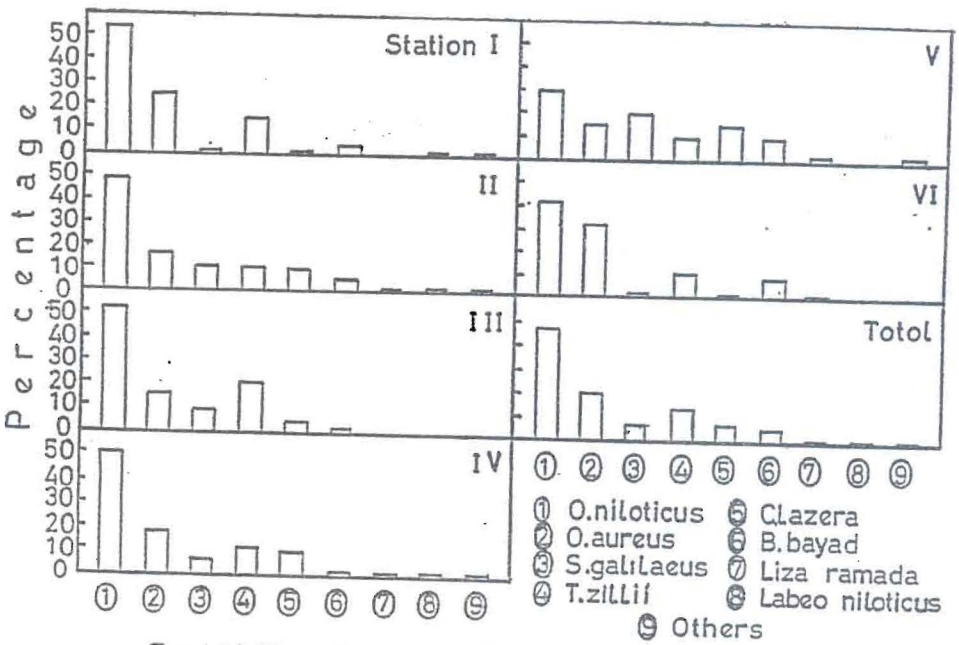


Fig.(3) Distribution of various fish species at different areas of Edku Lake. (2000)

Table (8): Weight and percentage weights of various fish species caught from different localities during the year 2000

Species	I		II		III		IV		V		VI		Total	
	Wt (kg)	%	Wt (kg)	%	Wt (kg)	%	Wt (kg)	%	Wt (kg)	%	Wt (kg)	%	Wt (kg)	%
O. niloticus	44.58	53.49	51.11	48.15	44.15	52.19	43.99	50.39	15.34	28.88	28.90	43.13	228.07	47.37
O. aureus	21.09	25.31	17.72	16.69	13.11	15.50	16.18	18.53	7.89	14.86	22.10	32.98	98.09	20.37
S. galilaeus	0.22	0.26	10.56	9.95	7.15	8.45	5.87	6.72	10.20	19.21	1.64	2.45	35.64	7.40
T. zillii	13.00	15.60	10.02	9.44	16.15	19.09	9.62	11.02	5.65	10.64	7.52	11.22	61.96	12.87
C. lazera	1.14	1.37	9.90	9.33	3.13	3.70	9.38	10.74	8.18	15.40	1.00	1.49	32.73	6.80
B. bayad	2.28	2.74	6.17	5.81	0.90	1.06	1.59	1.82	5.10	9.60	5.84	8.72	21.88	4.54
Labeo niloticus	--	--	--	--	--	--	0.14	0.16	0.02	0.04	0.01	0.02	0.17	0.03
Liza ramada	0.78	0.94	0.35	0.33	--	--	0.18	0.21	0.13	0.24	--	--	1.44	0.30
Anguila Sp.	--	--	0.25	0.26	--	--	0.35	0.40	--	--	--	--	0.60	0.12
Others.	0.25	0.30	0.07	0.06	--	--	--	--	0.60	1.10	--	--	0.92	0.19
Total	83.34		106.15		84.59		87.30		53.11		67.01		481.50	

It can be indicated from the data given that *O. niloticus* constituted the highest percent in the catch taken from all areas of the lake including those areas near to the lake sea connection. The percentage of this fish species ranged between 28.90% at station (V) and 53.49% by weight at station (I) with an average of 47.37% *O. aureus* was the second species in abundance next to *O. niloticus* comprising an average of 20.37% by weight through the whole area of the lake. The percentage of *O. aureus* in the experimental catch ranged between 14.86% at locality (V) to 32.98% at locality (VI).

The other two Tilapias *T. zillii* and *S. galilaeus* contributed with lower percentages in the experimental catch taken from all the fishing localities in the lake during the whole period of the present investigation which extended for about one and half years. It can be observed that the percentage abundance of these two species were inversely proportional with each others at all of the experimental localities of Edku lake. While *T. zillii* contributed with 15.60% in the experimental catch at locality (I), *S. galilaeus* constituted 0.26% only in this catch. The same observation was found at station VI where *T. zillii* constituted 11.22% by weight of the catch the other species *S. galilaues* comprised 2.45% of this catch. On the other hand *S. galilaues* was more abundant at locality (V) forming 19.21% of the catch while *T. zillii* formed 10.64% only of such catch.

This may indicate that the favorable environmental conditions for *T. zillii* to live in, are not so much favorable for *S. galilaeus*. Lake water of higher salinities is preferable for *T. zillii* while *S. galilaeus* prefers to live at lower salinity parts. This can be emphasized from the higher abundance of *T. zillii* at the areas adjacent to the lake sea connection which are characterized by higher salinity.

In agreement with the above observation, El-Shazly (1993) in his study on the biological characters of the four cichlid fish species at Mariut lake pointed out that *O. niloticus* is the most common fish species in the areas of low salinities while *T. zillii* is frequently common in the more saline areas. He indicated also that *T. zillii* is some times found with *O. aureus* near the openings leading to the sea at the north delta lakes. It was indicated by the same author also that *S. galilaeus* is less common than the other three species and often found with *O. niloticus* at the areas of low salinity especially near the drains.

The length frequency distribution of each of the four cichlid fish species caught from the different parts of Edku lake during the present study are given in Tables 9, 10, 11, and 12. The percentage weights and numbers of each species to the whole catch of cichlid fish are shown in the same tables.

Table 9 : Size composition of fish caught by trammel nets from station (I) at Edku lake

Length (cm)	Number of fish caught				
	O.niloticus	*O.aureus*	*S.galilaeus*	*T.Zillii*	Total
7.5		1		5	
8.5	2			29	
9.5	6	28	1	95	
10.5	48	100		148	
11.5	103	218	5	117	
12.5	81	132		36	
13.5	79	35		23	
14.5	80	17	1	12	
15.5	57	5	1	4	
16.5	54	5			
17.5	23	1			
18.5	18				
19.5	10				
20.5	7				
21.5	7				
22.5	2				
23.5	2				
24.5					
25.5					
26.5					
27.5					
28.5					
29.5					
Total number	579	542	8	469	1598
Average Length (cm)	13.98	11.77	12.13	10.84	
Standard deviation	± 2.65	1.26	1.92	1.43	
Total weight (Kgm)	44.580	21.090	0.220	13.000	78.89
Percentage by number	36.23	33.92	0.50	29.35	
Percentage by weight	56.50	26.73	0.27	16.48	

Table 10 : Size composition of fish caught by trammel nets from station (II) at Edku lake

Length (cm)	Number of fish caught				
	O.niloticus	*O.aureus*	*S.galilaeus*	*T.Zillii*	Total
7.5				1	
8.5	1	2	1	13	
9.5	52	7	1	30	
10.5	309	28		92	
11.5	291	121	1	131	
12.5	127	195	2	46	
13.5	127	97	5	19	
14.5	97	30	59	9	
15.5	37	19	46	6	
16.5	24	7	17	2	
17.5	19	11	17		
18.5	11	7	2		
19.5	10	2	2		
20.5	5	1			
21.5	8	1			
22.5	1				
23.5	1				
24.5	1				
25.5	1				
26.5					
27.5					
28.5					
29.5					
Total number	1122	528	153	349	2152
Average Length (cm)	12.36	12.81	15.32	11.36	
Standard deviation	2.33	1.71	1.47	1.40	
Total weight (Kgm)	51.105	17.715	10.560	10.015	89.395
Percentage by number	52.13	24.53	7.11	16.22	
Percentage by weight	57.17	19.82	11.81	11.20	

Table 11 : Size composition of fish caught by trammel nets from station (III) at Edku lake

Length (cm)	Number of fish caught				
	O.niloticus	*O.aureus*	*S.galilaeus*	*T.Zillii*	Total
7.5		1		3	
8.5	44	12		89	
9.5	53	60		205	
10.5	114	49		177	
11.5	138	134		177	
12.5	126	129	1	53	
13.5	72	54	21	16	
14.5	73	14	87	8	
15.5	41	9	44	9	
16.5	39	1	9	3	
17.5	33		6	3	
18.5	29		1		
19.5	16				
20.5	13				
21.5	5				
22.5	2				
23.5	2				
24.5	3				
25.5	1				
26.5					
27.5					
28.5					
29.5					
Total number	802	463	169	743	2177
Average Length (cm)	13.08	11.74	14.86	10.57	
Standard deviation	3.07	1.49	0.95	1.52	
Total weight (Kgm)	44.150	13.110	7.145	16.150	80.556
Percentage by number	36.84	21.27	7.76	34.13	
Percentage by weight	54.80	16.27	8.87	20.05	

Table 12 : Size composition of fish caught by trammel nets from station (IV) at Edku lake

Length (cm)	Number of fish caught				
	O.niloticus	*O.aureus*	*S.galilaeus*	*T.Zillii*	Total
7.5		1		5	
8.5	1	1	1	15	
9.5	16	3	1	25	
10.5	90	21	2	85	
11.5	131	152	8	87	
12.5	170	147	17	42	
13.5	138	53	28	25	
14.5	105	29	30	18	
15.5	54	14	19	6	
16.5	41	8	3	2	
17.5	20	1	1	1	
18.5	11				
19.5	8				
20.5	7				
21.5	2				
22.5	3				
23.5					
24.5	1				
25.5					
26.5	1				
27.5					
28.5	1				
29.5	1				
Total number	801	431	110	311	1653
Average Length (cm)	13.37	12.42	13.8	11.45	
Standard deviation	2.46	1.45	1.51	1.69	
Total weight (Kgm)	43.985	16.180	5.870	9.620	75.655
Percentage by number	48.46	26.07	6.65	18.81	
Percentage by weight	58.11	21.39	7.76	12.72	

Table 13 : Size composition of fish caught by trammel nets from station (V) at Edku lake

Length (cm)	Number of fish caught				
	O.niloticus	*O.aureus*	*S.galilaeus*	*T.Zillii*	Total
7.5		2		8	
8.5		6		16	
9.5		18	4	22	
10.5	38	76	6	44	
11.5	66	66	2	48	
12.5	100	10	16	36	
13.5	38	6	28	10	
14.5	58	4	76	6	
15.5	34		34	4	
16.5	8		12		
17.5	6		4		
18.5	2				
19.5					
20.5	1				
21.5					
22.5					
23.5					
24.5					
25.5					
26.5					
27.5					
28.5					
29.5					
Total number	351	188	182	194	915
Average Length (cm)	13.06	10.95	14.28	11.10	
Standard deviation	1.77	1.15	1.51	1.71	
Total weight (Kgm)	15..340	7.890	10.200	5.65	39.08
Percentage by number	38.36	20.55	19.89	21.20	
Percentage by weight	39.25	20.19	26.10	14.46	

Table 14 : Size composition of fish caught by trammel nets from station (VI) at Edku lake

Length (cm)	Number of fish caught				
	O.niloticus	*O.aureus*	*S.galilaeus*	*T.Zillii*	Total
7.5	1			1	
8.5		1		2	
9.5	14	3	1	19	
10.5	134	26	1	89	
11.5	139	130	1	102	
12.5	98	204	3	33	
13.5	60	92	5	10	
14.5	46	24	4	6	
15.5	36	12	5	1	
16.5	24	2	2		
17.5	23	1	2		
18.5	16				
19.5	1				
20.5	2	1			
21.5	2				
22.5	2				
23.5	1				
24.5					
25.5					
26.5					
27.5					
28.5					
29.5					
Total number	599	496	24	263	1382
Average Length (cm)	12.81	12.5	14.17	11.26	
Standard deviation	2.43	1.18	2.04	1.12	
Total weight (Kgm)	28.895	22.100	1.640	7.520	60.155
Percentage by number	43.3	35.89	1.74	19.03	
Percentage by weight	48.03	36.74	2.73	12.50	

Table 15 : Percentages of fish caught by trammel nets from different fishing localities of Edku lake.

Station		*O.niloticus*	*O.aureus*	*S.galilaeus*	*T.zilli*
% By Number	I	36.23	33.92	0.50	29.35
	II	52.13	24.53	7.11	16.22
	II	36.84	21.27	7.76	34.13
	IV	48.46	26.07	6.65	18.81
	V	38.36	20.55	19.89	21.20
	VI	43.34	35.89	1.7	19.03
% By Weight	I	56.50	26.73	0.27	16.48
	II	57.17	19.82	11.81	11.20
	III	54.80	16.27	8.87	20.05
	IV	58.11	21.39	7.76	12.72
	V	39.25	20.19	26.10	14.46
	VI	48.03	36.74	2.73	12.50

Table (16): Percentage weight of various fish species caught from different localities at Edku lake during 1990 (After Alsayes and Soliman 1993)

Locality / Species	I		II		III		IV		V		VI		Total	
	Wt	%	Wt	%	Wt	%	Wt	%	Wt	%	Wt	%	Wt	%
Oreochromis auraeus	1675	8.40	4970	32.55	4210	26.96	3470	16.25	2970	17.98	4070	25.32	21365	20.39
Tilapia zillii	2325	11.66	2850	18.67	4790	30.68	5570	26.08	5360	32.45	3050	18.97	23945	22.85
Sarotherodon galilaeus	440	2.21	200	1.31	60	0.38	430	2.01	755	4.57	500	3.11	2385	2.28
Oreochromis niloticus	1400	7.02	4230	27.71	1940	12.42	6805	31.85	1570	9.50	746	4.63	16690	15.93
Mugil cephalus	2465	12.36	170	1.11	1395	8.93	900	4.21	1150	6.96	1470	9.14	7560	7.21
Liza ramada	2755	13.82	150	0.98	1400	8.97	1035	4.85	1390	8.41	1160	7.22	7890	7.53
Clarias lazera	1130	5.66	367	2.40	270	1.73	1500	7.02	2395	14.50	3200	19.91	8862	8.46
Sparus aurata	460	2.31	--	--	--	--	--	--	--	--	--	--	460	0.43
Morone punctata	4275	21.44	80	0.52	310	1.99	320	1.50	390	2.36	710	4.42	6085	5.81
Morone labrax	2795	14.02	2060	13.49	890	5.70	1000	4.68	400	4.42	1010	6.28	8156	7.78
Other fish	220	1.10	190	1.24	350	2.24	330	1.54	140	0.85	160	1.00	1390	1.33
Total	**199**	**40**	**15267**		**15615**		**21360**		**16075**				**104777**	

It can be indicated from the data given in these tables that it may be hard to observe significant differences between the average lengths of any of the four species from one part of the lake to another. This means that the average lengths of the population of fish in the lake is more or less homogenous population.

D. Comparison between the species composition of fish population during the years 1990 and 2000:

It is a matter of fact that Edku lake has been receiving during the last 10 years increasing rates of waste water discharge. This discharge as well as the accumulation of high amounts of the decomposed aquatic vegetations on the bottom of the lake, increased the water level of the lake. As a result of the increased water level of the lake, it was difficult for the sea water to inflow inside the lake during most days of the year with the exception of few days through the winter season.

It was believed therefore that the species composition of fish population in this lake may have been changed during the last 10 years as a result of the difficulty that may face the marine fish species to migrate from the sea water to the lake for feeding where unfavourable ecological conditions may occur.

It is attempted in the species composition of fish populations in the lake during the year 2000 with that indicated by Alsayes and Soliman (1993) where they investigated the species composition of fish population in the lake ten years back i.e. during the year 1990.

Tables (16) and (8) show the species composition of the experimental catch taken from the various parts of the lake during the years 1990 and 2000 respectively.

The data given in these tables are graphically represented by Fig. (3) and (4) in respective.

It can be pointed out from the data given in these tables that:

1. The marine fish species ***Mugil cephalus***, ***Liza ramada***, ***Morone labrax***, and ***Morone punctata*** were participated in the experimental catch taken from all the sampling areas of the lake during 1990. Higher percentages of these species were found at the area adjacent to the lake sea connection (area I).

The marine fish species ***Sparus aurita*** was participated in the experimental catch taken from area I only and comprised 2.31% by weight of such catch during 1990.

The above marine fish species comprised 28 76% of the total experimental catch taken during the vear 1990

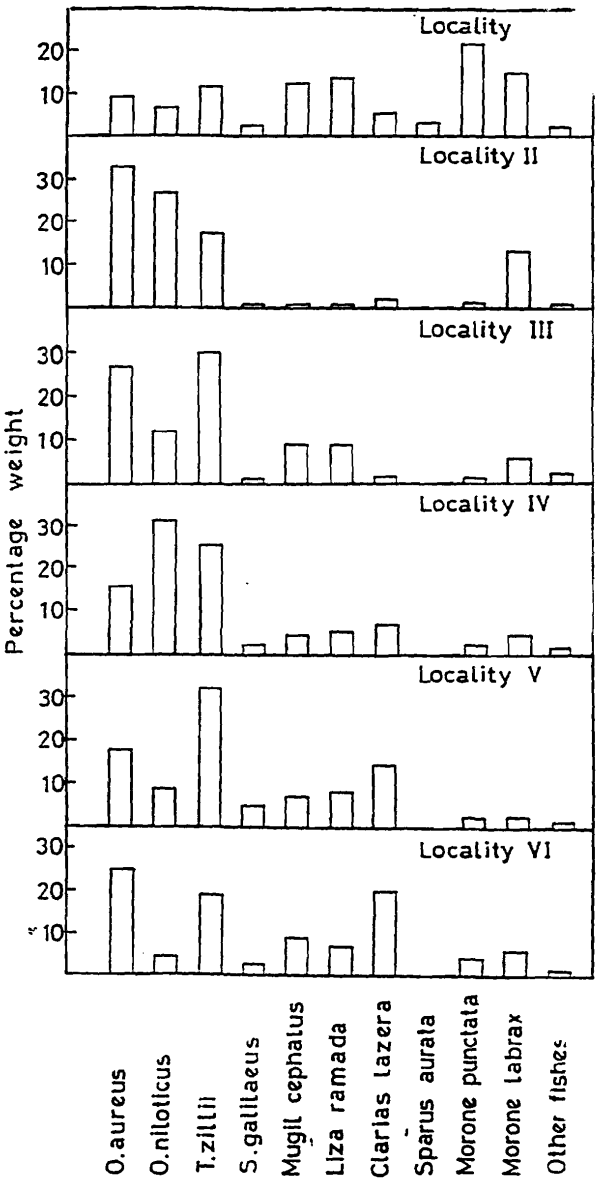
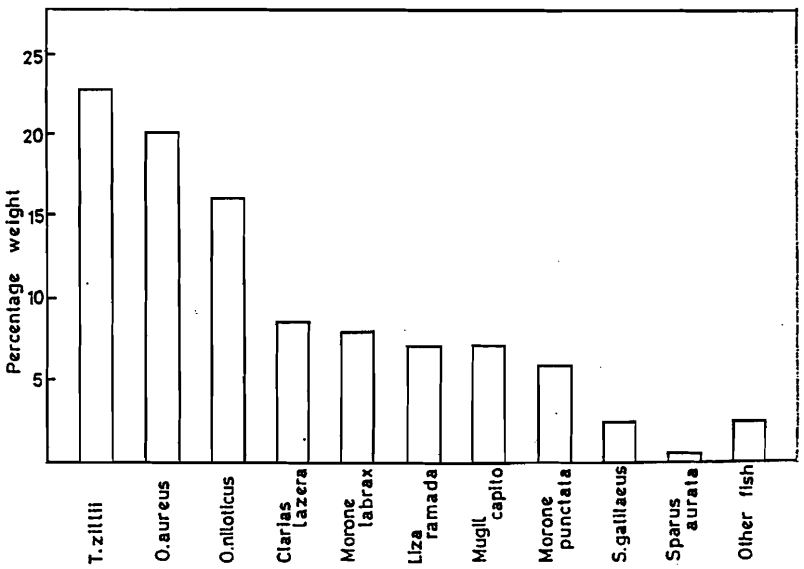


Fig.(4):Species composition of the experimental catch taken from the various fishing localities. (1990)



ng.(5):Percentage weight of the various fish species caught from Lake Edku during the whole period of study. 1980

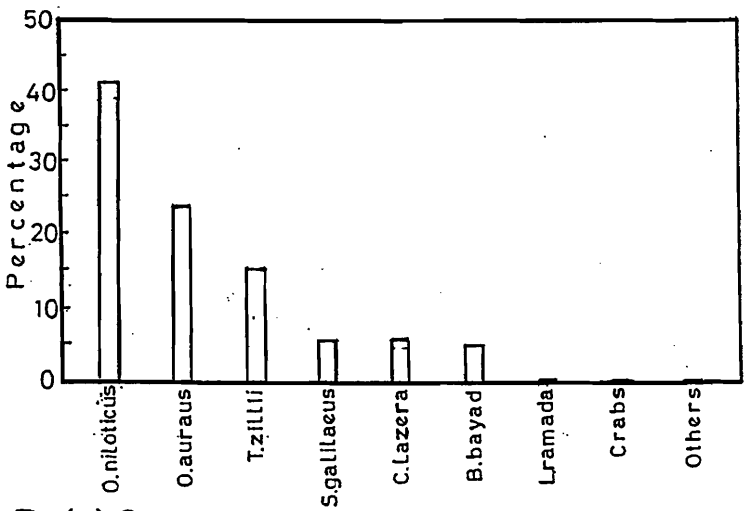


Fig.(6.): Species composition of the total experimental catch taken by trammel net. during the year 2000

2. The marine fish species ***Liza ramada*** was participated with few individuals in the catch taken from the whole area of the lake and comprised 0.30% by weight of the experimental catch during the year 2000. ***Anguilla sp.*** was caught from two areas of the lake constituting 0.12% by weight of the total experimental catch.The marine fish species comprised 0 42% of the whole experimental catch of the vear 2000

3. The four Cichlid fish species ***O. niloticus***, ***O. aureus***, ***T. zillii***, and ***S. galilaeus*** were caught from the various areas of the lake during the years 1990 and 2000. ***O. niloticus*** dominated the experimental catch at these different areas during the year 2000 while ***O. aureus*** was more dominant at the same areas during the year 1990.

4. The cat fish species ***Clarias lazera*** was caught from all the areas of the lake during the years 1990 and 2000 comprising 8.46% and 6.80% by weight during the two years respectively.

5. The fresh water fish species ***Bagrus bayad*** was participated in the catch taken from all of the fishing localities of the lake during the year 2000. Higher abundance of this fish species was observed at the areas far from the lake sea connection. It comprised 9.60% and 8.72% by weight of the catch taken from stations V and VI, while it comprised 1.06% and 2.74% only in the catch taken from the areas near the lake sea connection. ***Bagrus bayad*** constituted 4.54% by weight of the experimental catch taken during the year 2000 while it appeared with low contribution as a category of other fish in the catch of 1990.

6. The contribution of the marine fish species was very low during the year 2000 in comparison with its contribution 10 years back indicating that these species were very rarely living or present in the lake. This can be attributed to:

a. The discharge of high rates of sewage water which include domestic, agricultural and industrial wastes flowing at Abu Qir Bay and Edku lake. This discharge created unfavourable conditions for the fish fry of the marine species for migration feeding and accommodation in the lake.

b. Fishing the fish fry of the marine species with high rates from its natural sources with the aim of stocking a large number of fish farms that have been recently established at the borders of the lake

c. The unfavourable conditions due to silting of the lake sea connection which may not allow the process of feeding migration and movements of the marine fish fry towards the lake.

Summary and conclusions

The following points can be concluded from the present study:

(1) ***Oreochromis niloticus*** dominated the experimental catch caught from the lake by the use of trammel nets having different mesh sizes. This fish species comprised 41.82% by weight of the catch. Next to ***O. niloticus*** was ***Oreochromis aureus*** which constituted 23.61%. On the other hand ***Sarotherodon galilaeus*** and ***Tilapia zillii*** contributed with 7.37% and 14.33% respectively of the whole experimental catch taken during the year 2000. The cat fish species ***Bagrus bayad*** and ***Clarias lazera*** formed 5.45% and 7.21% of the catch. It is believed that the low salinity of Edku lake water favoured the abundance of these fresh water species.

(2) The average lengths of ***O. niloticus***, ***O. aureus***, ***T. zillii*** and ***S. galilaeus*** were found to be 13.03 cm, 12.74 cm, 10.96 cm and 14.62 cm respectively. This leads us to conclude that ***S. galilaeus*** grows faster than the other three species. It was possible to conclude also that the four Cichlid fish species are mainly caught during the second or third years of their life. The average lengths of the two cat fish species ***C. lazera*** and ***B. bayad*** were found as 30.55 cm and 23.79 cm respectively.

(3) ***O. niloticus*** constituted the highest percentage in the catch taken from the six experimental localities in the lake even at that locality adjacent to the lake sea connection. ***O. aureus*** was the second in abundance in the whole parts of the lake. The favourable ecological conditions for ***T. zillii*** to live in were not so favourable to ***S. galilaeus***. As ***T. zillii*** prefers to accommodate and live in the parts of the lake having comparatively higher water salinities, it was found that the other parts characterized by lower salinity favours the living of ***S. galilaeus***.

(4) It was difficult to observe significant differences between the average lengths of any of the four Tilapia species from one area to another in the lake. This leads us to conclude that these species distribute in homogenous way throughout the lake.

(5) A comparison between the abundance of the marine fish species in the lake during the years 1990 and 2000 showed that these species contributed with 28.76% by weight in the experimental catch taken during the year 1990, while this contribution decreased significantly. To be 0.42% only during the year 2000.This drastic decrease can be attributed to some ecological factors such as water pollution in both the lake as well as Abu Qir Bay which have been created as a result from discharging waste water with high rates to the two areas during the last few years.Fishing the fish fry with large numbers and the unfavourable conditions of the lake sea connection are other factors.

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