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Impact of drainage effluents on the condition of Cichlid (tilapias) fish in Lake Edku, Egypt

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Abstract

A total of 1011, 959 and 830 Cichlid fish, *Oreochromis niloticus, Tilapia zillii, Sarotherodon galilaeus* and *Oreochromis aureus* were monthly collected from El-Boughaz area, outlets of Edku and Bosily Drains and outlet of Barsik Drain, north, east and south of the Lake Edku, during the period 2001-2003. The length-weight relationship (LWR) was significantly correlated, the values of coefficient of determination r^2 were very close to 1.0 and significant at 0.05 level and the slop *b* significantly differs from 3 (F = 7.072, P < 0.05) for all fish species from the three areas. All fish species showed slightly positive allometric growth. The averages of relative condition factor *Kn* for all fish species from the three studied areas were found to be equal 1.0 and the averages of allometric condition factor *Ka* were 1.4, 1.3, 1.0; 1.3, 1.4, 1.3; 1.5, 1.4, 1.4 and 1.3, 1.3, 1.0, meanwhile, the values of natural mortality *M* were 0.7481, 1.1058, 0.5843; 1.2379, 1.1122, 0.8786; 0.7404, 1.3506, 1.0446 and 0.9786, 2.0558, 0.4087 for *O. niloticus, T. zillii, S. galilaeus* and *O. aureus,* respectively. Statistically, *Ka* showed insignificant deference either depending on areas (F = 2.59 , P = 0.129) or on species (F = 1.67 , P = 0.250), while, *M* was significant (F = 4.31 , P < 0.05) depending on areas and insignificant (F = 0.281 , P > 0.05) depending on species. The condition of fish species at the three studied areas was found, approximately, comparable. There is no difference of the stress effect on fish species from one area to another of Lake Edku.

Keywords: Lake Edku, Cichlid fish, fish condition, natural mortality.

1. Introduction

Lake Edku is one of five northern lakes at Mediterranean coast of Egypt. The fish production of the lake comprises *Cichlidae, Anguilidae, Mugilidae, Moronidae, Clariidae, Cyprinidae* and others. The yearly production of Cichlid fish during the period 2000-2009 is 6762, 8541, 7979, 8425, 7943, 8480, 7629, 6411, 5744 and 6105 Tons (GAFRD, 2009).

The lake receives huge amounts, 83-280 X 10^6 m^3 / day, of various effluents (Shraidah and Tayel, 1992). Mainly, two drains: El-Khairy from the east and Barsik from the south discharge their effluents into the lake. El-Khairy Drain is joined to three sources of drainage water coming from El-Bosily, Edku and Damanhur sub-drains which transport domestic, agricultural and industrial wastewaters. Barsik Drain transports, mainly, agricultural drainage water as well as the wastes of Barsik fishing ponds of 2000 feddans (Youssef and Masoud, 2004). These drainage waters create, in most times, water movement through the lake from both the east and south to the north. The lake, also, receives seawater through Boughaz El-Maadia, at low tide, from Abu-Qir Bay which is a semicircular basin receiving considerable amounts of raw industrial wastes from many factories through El-Tabia pumping station with an average of about 1850 X 10^3 m^3 / day (Aboul-Ezz and Soliman, 2000). Lake Edku was classified among oligotrophic lakes (Salah, 1960, 1961). Due to the high inputs of nutrient rich effluents, the Lake became hypertrophied (Gharib, 1998).

The configuration, hydrography and chemical characteristics of Lake Edku have been investigated by many authors. Abbas, *et al.* (2001) investigated the chemical composition of Lake Edku water. Shakweer (2006), investigated the impact of drainage water on the hydrographic and chemical parameters of both lake and drainage water. Aboul-Ezz and Soliman (2000) and Soliman (2005), considered the distribution, community composition and changes occurring in the zooplankton density, species composition and its estimated diversity in Sea, Boughaz, Lake and drains sectors in relation to environmental condition. Zaghloul and Hussein (2000), studied the impact of pollutants disposal on population density and species structure of the phytoplankton population of Lake Edku. El-Shenawy *et al.* (2000) and El-Shenawy (2005), determined the prevalence of *Aeromonas* spp. and fecal indicator bacteria and some other pathogens in Lake Edku and drainage water discharged into the lake.

Shakweer and Abbas (2005), discussed the effect of various environmental and biological factors which influence the uptake of Cu, Zn, Ni, and Pb by the most dominant macrophytes and fish species at Lake Edku. The accumulation of Cu, Zn and Ni in the flesh, liver, gonads and bones of fish were negatively correlated with fish length. Khadr (2005), compared copper concentrations among different phases using sequential technique.

Alsayes (2002), stated that the distribution of fish population in the lake is affected mainly by the environmental conditions, hydrochemical and hydrobiological characters. It is believed that the high rates of wastewater discharge in Lake Edku during the last ten years could drastically affect the marine life as well as the abundance and distribution of fish in the lake, specially those species of marine origin. Abd-Alla and Talaat (2000), investigated growth, mortality and rate of exploitation for the different populations of tilapias in Lake Edku.

The aim of this work is to find out the extent to which the discharged effluents affected the condition of fish at east, middle and north of the lake. For this objective fish samples were collected from three areas: Boughaz El-Maadia (north), Edku and Bosily Drains outlets (east) and Barsik Drain outlet (middle). The length-weight relationship, condition factor, growth performance and natural mortality were calculated for evaluating the condition of the four Cichlid fish at the three areas.

2. Materials and Methods

2.1. Study area

Lake Edku is a shallow brackish lagoon situated between latitudes of 31° 10` and 31° 18` N, and longitudes of 30° 8` and 30° 22` E (Figure 1). It extends about 27 km to the east of Abu-Qir Bay with width ranged between 6-11 km and average depth of 1 m and is connected to the Mediterranean at El-Maadia city at the north-west.

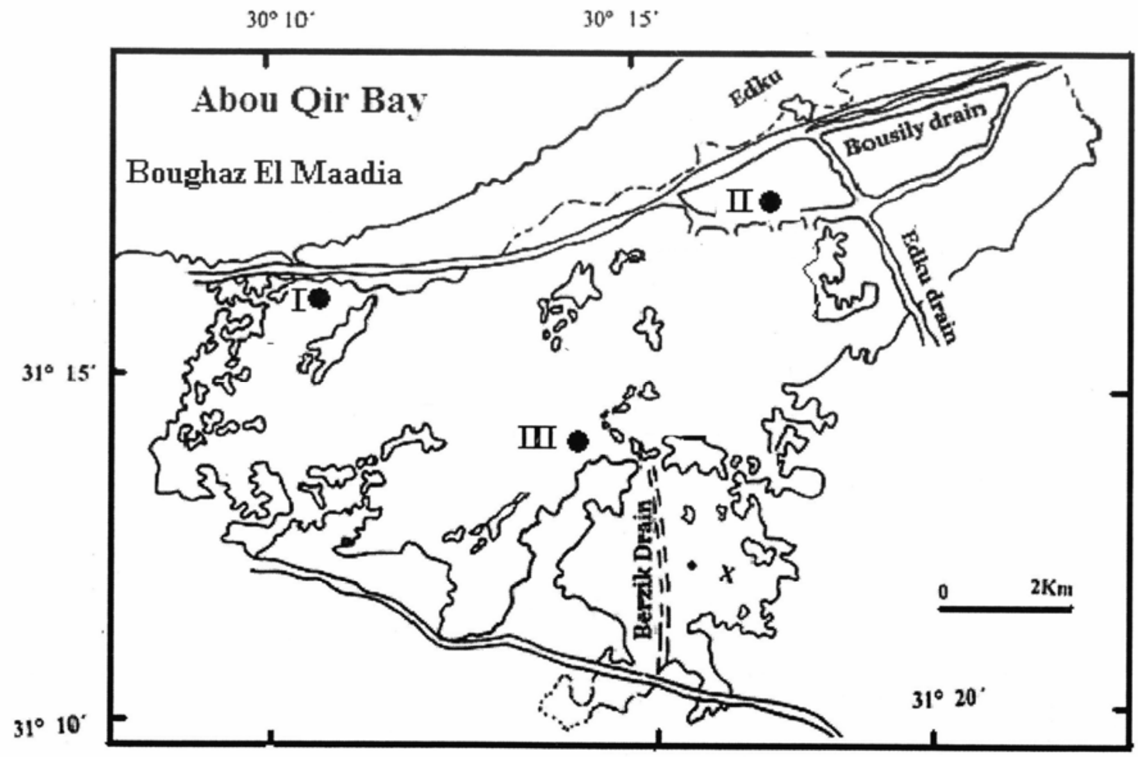

Figure 1. Lake Edku and location of the sampling stations.

2.2. Fish samples

A total of 1011, 959 and 830 fish were monthly collected from El-Boughaz area (north of the lake), outlets of Edku and Bosily Drains (east of the lake) and outlet of Barsik Drain (middle of the lake) during the period from 2001-2003. The fish were identified and total length (cm), total weight (gm) and gutted weight (gm) were measured. The length-weight relationship (LWR) was estimated by using the equation:

$\mathbf{W = aL^b}$ (Ricker, 1973; Tesch, 1971) (1), (1) where:

W = calculated weight (gm), L = observed total length (cm), a = intercept or initial growth coefficient, b = slope or growth coefficient. r^2 = coefficient of determination.

Allometric condition factor (Ka) was estimated by using the equation:

$\mathbf{Ka = (W / L^b) \times 100}$ (Le Cren, 1951), (2)

where:

W = fish observed weight, L = fish observed total length, b = the constant calculated from the LWR equation (1).

Relative condition factor (Kn) was estimated by equation:

$\mathbf{Kn = W_{obs.} / W_{cal.}}$ (Le Cren, 1951), (3)

where:

$W_{obs.}$ = fish observed weight, $W_{cal.}$ = fish calculated weight obtained from equation (1).

The data of fish length and weight were used for calculating the fish asymptotic length *L*∞, growth performance *K* and natural mortality *M* by FISAT-II software, then, natural mortality was calculated by applying the values of L∞ and K in Pauly's equation:

$\mathbf{Ln\ (M) = -\ 0.0152 - 0.279\ Ln\ L\infty + 0.6543\ LnK + 0.4634\ LnT}$ (4) where:

M = natural mortality, L∞ = asymptotic length, K = growth performance, T = average temperature 22° C.

2.3. Statistical analyses

Statistical calculations for LWR parameters a, b and r^2 were carried out using Microsoft Excel-2003. Analyses of variance ANOVA were carried out by using SPSS-10 software. Fish asymptotic length *L*∞, growth performance *K* and natural mortality *M* were calculated by using FISAT-II software.

3. Results

The range and average of total length and gutted weight of fish collected from El-Boughaz area, Edku and Bosily drains and Barsik drain outlets are shown in Table 1. The averages of total length were 12.8, 12.9, 14.5; 10.5, 10.1, 10.6; 11.2, 10.4, 11.4 and 10.4, 10.6, 10.9 cm, while, the averages of gutted weight were 39.2, 41.3, 63.2; 22.7, 19.8, 21.9; 33.0, 24.5, 21.9 and 18.2, 21.1, 20.9 gm for *O. niloticus, T. zillii, S. galilaeus and O. aureus,* respectively.

The length-weight relationship (LWR) of telapian fish collected from the different locations are shown in figures 2, 3, 4 and the parameters of LWR are shown in Table 2. The values of the intercept (initial growth coefficient) *a* were found to be: 0.0135, 0.0129, 0.0103; 0.0130, 0.0139, 0.0127; 0.0147, 0.0143, 0.0137 and 0.0130, 0.013, 0.0102, and the values of slope (growth coefficient) *b* were found to be 3.0931, 3.1013, 3.1823; 3.1121, 3.0830, 3.1163; 3.0896, 3.0823, 3.0782 and 3.0691, 3.0620, 3.1443, meanwhile, values of the coefficient of determination r^2 were found to be 0.9884, 0.9856, 0.9906; 0.9858, 0.9754, 0.9656; 0.9867, 0.9897, 0.9889 and 0.9700, 0.9855, 0.9558 for *O. niloticus, T. zillii, S. galilaeus and O. aureus,* respectively.

The allometric condition factor *Ka* was calculated and ranged from 1.2-1.5, 1.0-1.7, 0.8-1.2 with averages 1.4, 1.3, 1.0; 1.1-1.06, 0.9-1.8, 0.9-1.8 with averages 1.3, 1.4, 1.3; 1.0-1.9, 1.2-1.8, 0.9-1.6 with averages 1.5, 1.4, 1.4 and 1.0-1.6,1.0-1.7, 0.7-2.0 with averages 1.3, 1.3, 1.0 for *O. niloticus, T. zillii, S. galilaeus and O. aureus* from at El-Boughaz, Edku and Bosily Drains and Barsik Drain areas, respectively, (Table 1). Statistically, *Ka* was found to be insignificant either depending on areas ($F = 2.59$, $P > 0.05$) or species ($F = 1.67$, $P > 0.05$)**.** The range of relative condition factor *Kn* are: 0.9-1.1, 0.8-1.3, 0.8-1.2; 0.8-1.2, 0.7-1.3, 0.7-1.4; 0.7-1.3, 0.8-1.3, 0.7-1.2 and 0.8-1.3,0.-1.3, 0.8-1.3, 0.71.4 for *O. niloticus, T. zillii, S. galilaeus and O. aureus,* respectively. The average values for all species equal 1.0 (Table 1).

The values of growth performance *K*, asymptotic length *L*∞ and natural mortality *M* of fish from the three studied areas are shown in Table 3. The values of *K* were found to be 0.27, 0.48, 0.20; 0.53, 0.45, 0.33; 0.26, 0.68, 0.44 and 0.36, 1.21, 0.10, and values of *L*∞ were 21.00, 19.95, 25.20; 16.80, 16.80, 18.90; 19.95, 22.05, 19.95 and 15.75, 18.90, 17.85, while, values of *M* were 0.7481, 1.1058, 0.5843; 1.2379, 1.1122, 0.8786; 0.7404, 1.3506, 1.0446 and 0.9786, 2.0558, 0.4087 for *O. niloticus, T. zillii, S. galilaeus* and *O. aureus*, respectively.

Table 1. Total length (cm), Gutted weight (gm), Allometric condition factor (Ka) and Relative condition factor (Kn) of the four telapian species at El-Boughaz, Edku-Bosily Drains and Barsik Drain areas.

Area	Species	N	Total length (cm)		Gutted weight (gm)		Allometric condition factor (Ka)		Relative condition factor (Kn)	
			Range	Av. (±S.d.)	Range	Av. (±S.d.)	Range	Av. (±S.d.)	Range	Av. (±S.d.)
El-Boughaz	O. n.	112	6.9-17.6	12.8 (2.26)	6.0-94.0	39.2 (21.09)	1.2-1.5	1.4 (0.08)	0.9-1.1	1.0 (0.06)
	T. z.	314	6.7-16.2	10.5 (2.14)	5.0-78.0	22.7 (15.37)	1.1-1.6	1.3 (0.10)	0.8-1.2	1.0 (0.07)
	S. g.	290	6.6-21.0	11.2 (3.18)	4.0-187.0	33.0 (33.15)	1.0-1.9	1.5 (0.14)	0.7-1.3	1.0 (0.09)
	O. a.	295	8.4-14.7	10.4 (1.54)	9.0-53.0	18.2 (8.86)	1.0-1.6	1.3 (0.10)	0.8-1.3	1.0 (0.08)
Edku & Bosily Drain	O. n.	169	7.2-19.4	12.9 (2.76)	5.0-140.0	41.3 (26.69)	1.0-1.7	1.3 (0.11)	0.8-1.3	1.0 (0.08)
	T. z.	271	7.2-15.6	10.1 (2.00)	5.0-70.0	19.8 (13.19)	0.9-1.8	1.4 (0.13)	0.7-1.3	1.0 (0.09)
	S. g.	210	6.5-20.7	10.4 (2.85)	4.0-162.0	24.5 (23.64)	1.2-1.8	1.4 (0.12)	0.8-1.3	1.0 (0.08)
	O. a.	309	7.1-17.5	10.6 (2.30)	6.0-85.0	21.1 (14.80)	1.0-1.7	1.3 (0.10)	0.8-1.3	1.0 (0.08)
Barsik Drain	O. n.	159	7.3-23.5	14.6 (3.52)	5.0-236.0	63.2 (48.98)	0.8-1.2	1.0 (0.08)	0.8-1.2	1.0 (0.07)
	T. z.	231	6.8-17.6	10.6 (1.82)	4.0-103.0	21.9 (13.27)	0.9-1.8	1.3 (0.12)	0.7-1.4	1.0 (0.10)
	S. g.	179	7.1-18.6	11.4 (2.78)	6.0-114.0	29.6 (22.02	0.9-1.6	1.4 (0.10	0.7-1.2	1.0 (0.08)
	O. a.	261	6.7-16.8	10.9 (2.04)	6.0-63.0	20.9 (12.04)	0.7-2.0	1.0 (0.14)	0.7-1.4	1.0 (0.13)

(O.n.) = *Oreochromis niloticus*, (T.z.) = *Tilapia zillii*, (S.g.) = *Sarotherodon galilaeus*, (O.a.) = *Oreochromis aureus*.

Table 2. Length-weight relationship parameters a (intercept) , b (slop) and r^2 (correlation coefficient) of telapian species at El-Boughaz, Edku-Bosily Drains and Barsik Drain.

Area	Species	a	b*	r^{2*}
El-Boughaz	O.n.	0.0135	3.0931	0.9884
	T.z.	0.0130	3.1121	0.9858
	S.g.	0.0147	3.0896	0.9867
	O.a.	0.0130	3.0691	0.9700
Edku-Bosily Drains	O.n.	0.0129	3.1013	0.9856
	T.z.	0.0139	3.0830	0.9754
	S.g.	0.0143	3.0823	0.9897
	O.a.	0.0131	3.0620	0.9855
Barsik Drain	O.n.	0.0103	3.1823	0.9906
	T.z.	0.0127	3.1163	0.9656
	S.g.	0.0137	3.0782	0.9889
	O.a.	0.0102	3.1443	0.9558

(O.n.) = *Oreochromis niloticus*, (T.z.) = *Tilapia zillii*, (S.g.) = *Sarotherodon galilaeus*, (O.a.) = *Oreochromis aureus*.
*b: significant ($F = 7.072$, $P < 0.05$), *r^2 : significant ($P < 0.05$)

Table 3. Asymptotic length ($L\infty$), growth coefficient (K) and natural mortality (M) of telapian species at El-Boughaz, Edku-Bosily Drains and Barsik Drain.

Area	Species	$L\infty$	K	M*
El-Boughaz	O.n.	21.00	0.27	0.7481
	T.z.	16.80	0.53	1.2379
	S.g.	19.95	0.26	0.7404
	O.a.	15.75	0.36	0.9786
Edku-Bosily Drains	O.n.	19.95	0.48	1.1058
	T.z.	16.80	0.45	1.1122
	S.g.	22.05	0.68	1.3506
	O.a.	18.90	1.21	2.0558
Barsik Drain	O.n.	25.20	0.20	0.5843
	T.z.	18.90	0.33	0.8786
	S.g.	19.95	0.44	1.0446
	O.a.	17.85	0.10	0.4087

(O.n.) = *Oreochromis niloticus*, (T.z.) = *Tilapia zillii*, (S.g.) = *Sarotherodon galilaeus*, (O.a.) = *Oreochromis aureus*.
* M: significant ($F = 4.31$, $P < 0.05$), dependent on areas, insignificant ($F = 0.281$, $P > 0.05$), dependent on species.

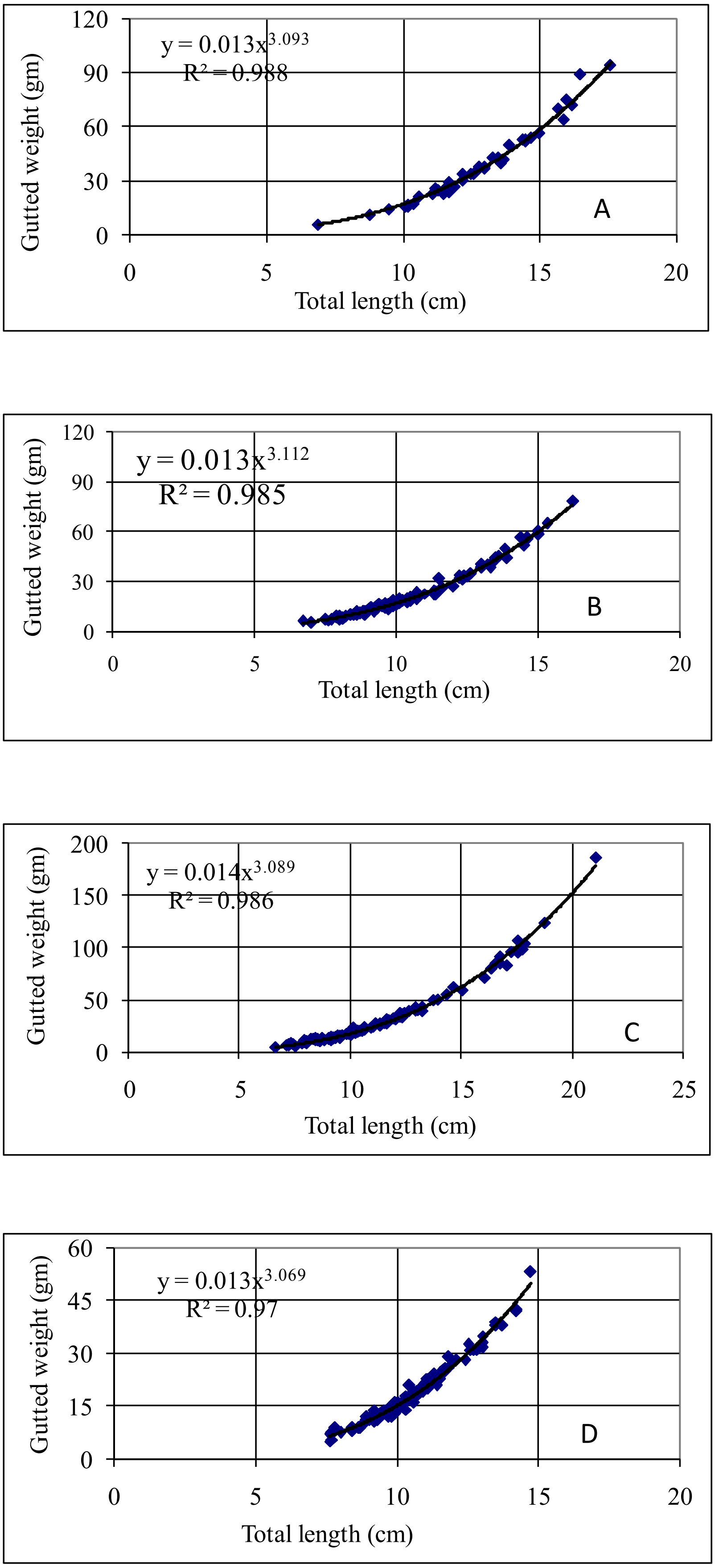

Figure 2: Length-weight relationship of O. niloticus (A), T. zillii (B), S. galilaeus (C) and O.aureus (D) in El-Boughaz area.

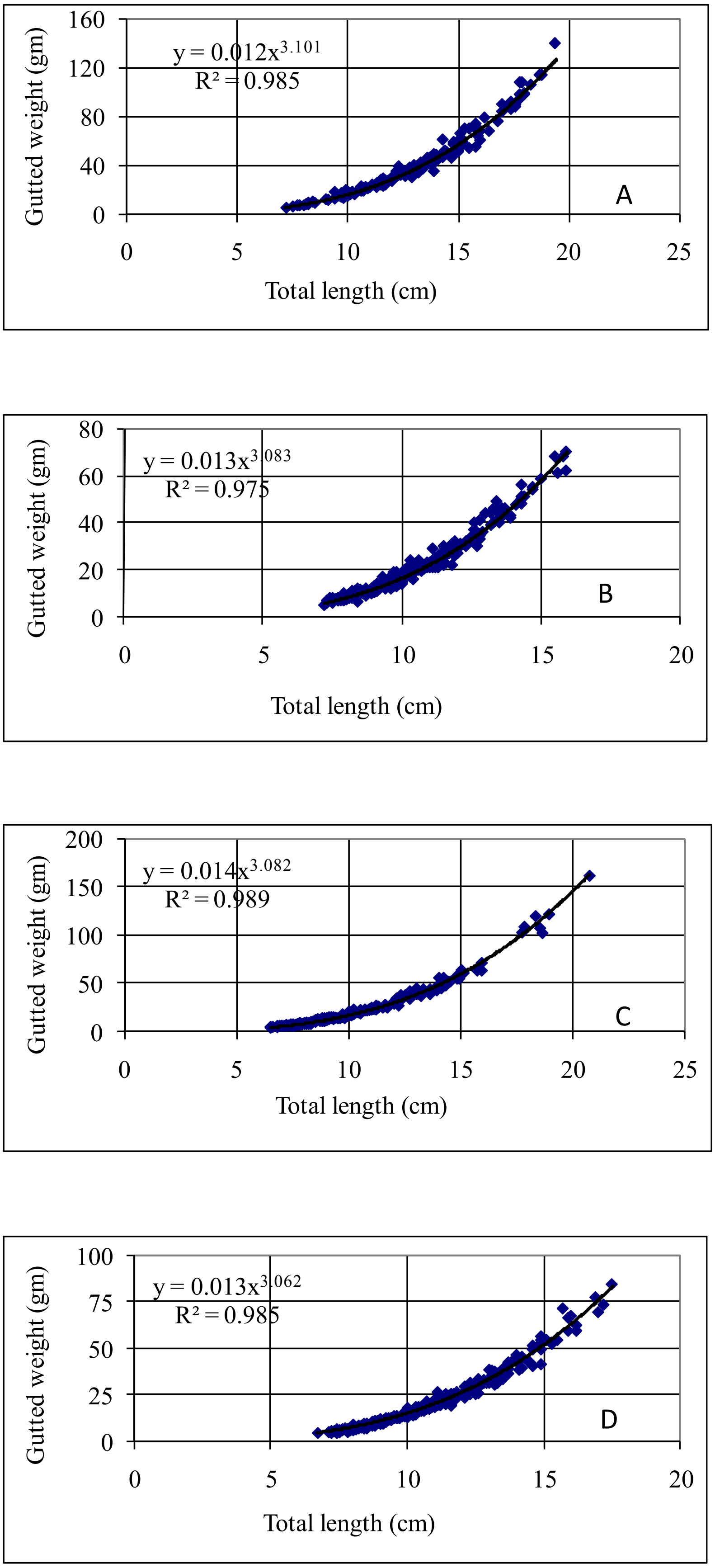

Figure 3: Length-weight relationship of O. niloticus (A), T. zillii (B), S. galilaeus (C) and O.aureus (D) in Bosily and Edku area.

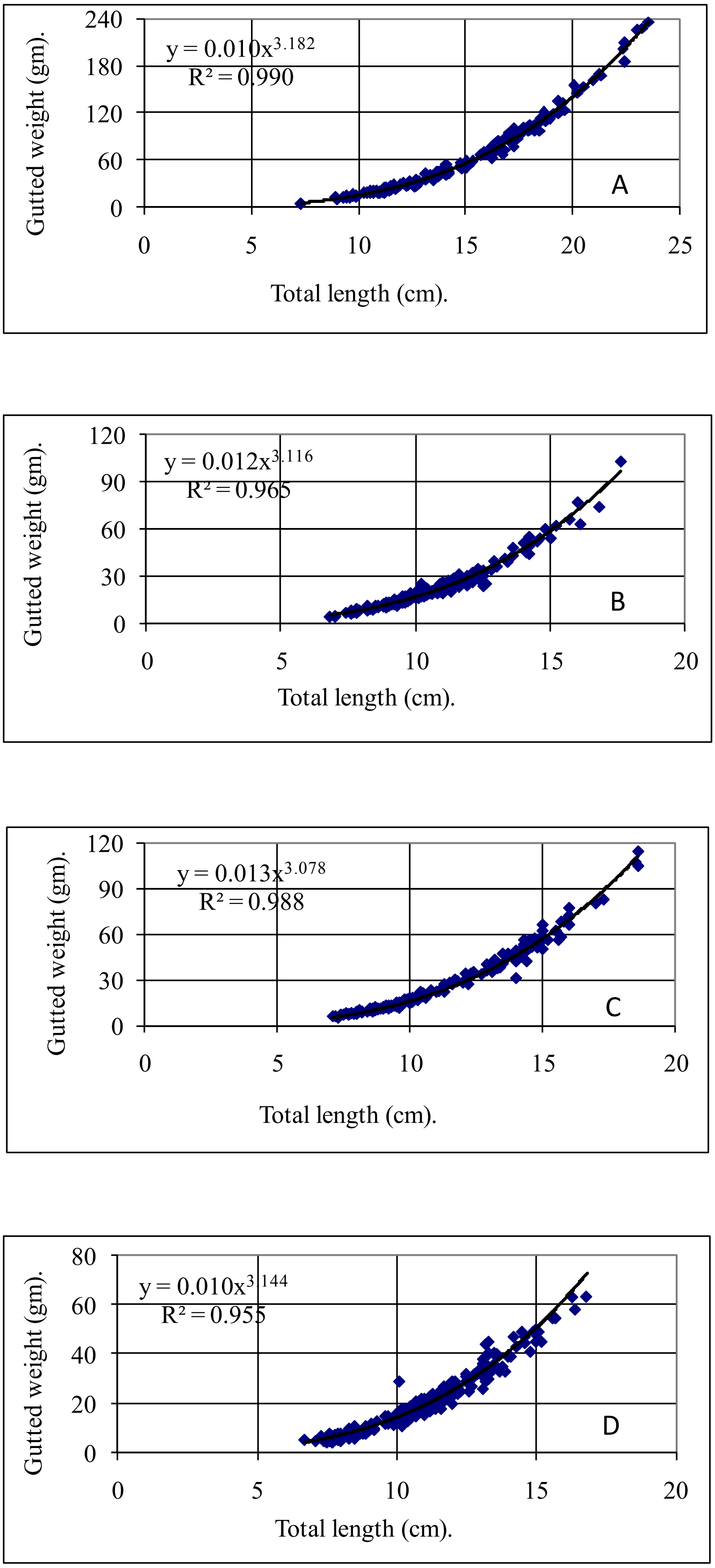

Figure 4: Length-weight relationship of O. niloticus (A), T. zillii (B), S. galilaeus (C) and O.aureus (D) in Barsik drain area.

4. Discussion

Morphometric relationship between length and weight (LWR) is of great importance in fishery biology assessments. LWR can be used to assess the well-being of individuals and to determine the possible differences between separate unit stocks of the same species (Ndimele, *et al.,* 2010; Kumolu-Johnson and Ndimele, 2011). In conjunction with age data, LWR can give information on stock composition, life span, mortality, growth and production (Fafioye and Oluajo, 2005; Orhan *et al.*, 2009). Pauly (1983) stated that LWR provides valuable information on the habitat where the fish lives while Kulbicki *et al.* (2005) stressed the importance of LWR in modeling aquatic ecosystems.

LWR is originally used to provide information on the condition of fish, and may help to determine the fish somatic growth (Ricker, 1973; Bagenal and Tesch, 1978). Pauly (1983) suggested the following situations when LWR may be needed: (1) the conversion of length of individual fish to weight, (2) estimating the mean weight of fish of a given length, (3) conversion of growth equation for length into a growth equation for weight and (4) morphological comparisons between populations of the same species or between species.

In the present study, the averages of total length were found to be 12.8, 12.9, 14.6; 10.5, 10.1, 10.6; 11.2, 10.4, 11.4 and 10.4, 10.6, 10.9 cm, while, the averages of gutted weight were 39.2, 41.3, 63.2; 22.7, 19.8, 21.9; 33.0, 24.5, 29.6 and 18.2, 21.1, 20.9 gm for, *O. niloticus, T. zillii, S. galilaeus* and *O. aureus* from the three studied areas, respectively.

Alsayes (2002), found in an experimental catch at different areas of the Lake Edku, that *O. niloticus, T. zillii, S. galilaeus* and *O. aureus* comprised 41.82%, 14.33%, 7.21% and 23.61 % by weight and observed insignificant differences between the average length of any of the four tilapia species, 13.1, 11.0, 14.6 and 12.7 cm for *O. niloticus, T. zillii, S. galilaeus* and *O. aureus* from one area to another in the lake. This leads to conclude that these species distribute in a homogenous way throughout the lake.

Bagenal and Tesch (1978) stated that the growth exponent *b* in the LWR has values between 2 and 5. LWR may help to determine whether somatic growth is isometric (i.e., without changing body shape) $b = 3$, negative ($b < 3$) or positive ($b > 3$) allometric (i.e., fish changes shape as it grows larger) (Ricker, 1973).

In the present study, fish at the three studied areas of Lake Edku grow in weight slightly more than they grow in length (positive allometric growth) because the values of *b* coefficient of different fish species were found slightly higher than 3. The values of *b* were found to be significantly different from 3, depending on species ($F = 7.0721$, $P < 0.05$), although some of these values differed only slightly, while, depending on areas, they were found to be insignificant ($F = 3.14$, $P = 0.092$).

Abd-Alla and Talaat (2000), found *O. niloticus* ($a = 0.01702$, $b = 3.03264$) and *S. galilaeus*. ($a = 0.01727$, $b = 3.04138$) grow in weight, slightly, higher than they grow in length (positive allometric growth), while, *T. zillii* ($a = 0.04005$, $b = 2.68754$) and *O. aureus* ($a = 0.03260$, $b = 2.75284$) grow in weight lesser than they grow in length (negative allometric growth) in Lake Edku. Abaza (2008), found two cichlid fish *O. niloticus* ($b = 2.85$) and *T. zillii* ($b = 2.84$) became lighter in weight as they grow in length (negative allometric growth) at Lake Mariut.

The association degree between length and weight variables can be calculated by the determination coefficient r^2. In present study the values of r^2 were found to be 0.9884, 0.9856, 0.9906, for *O. niloticus,* 0.9858, 0.9754, 0.9656, for *T. zillii,* 0.9867, 0.9897, 0.9889, for *S. galilaeus,* 0.9700, 0.9855, 0.9558, for *O. aureus* at El-Boughaz, Edku-Bosily, Barsik areas, respectively, (Table 2). All values of r^2 were found to be significance at the level 0.05. This means that fish grow in weight in proportional with growth in length. Abaza (2008), found $r^2 = 0.986$ for *O. niloticus* and $r^2 = 0.976$ for *T. zillii* at Lake Mariut.

The condition factor is used in order to compare the condition, fatness or wellbeing of fish. It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal, 1978). Condition factor is also a useful index for monitoring of feeding intensity, age, and growth rates in fish (Oni *et al.*, 1983). It is strongly influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which fish live (Anene, 2005). When *b* of the LWR is different from 3, the allometric condition factor $Ka = 100 \times W/L^b$ is more appropriate than Fulton's cube law $K = 100xW/L^3$ for comparisons of condition within the same group because *Ka* eliminates the influence of fish size from the estimation of fish condition (Bagenal and Tesch, 1978). The relative condition factor $Kn = W_{obs.}/W_{cal.}$ can also be used to compare conditions between species. The average *Kn* across all lengths and species is 1.0 (Anderson and Neumann, 1996). Bolger and Connolly (1989), however, shows that *Kn* comparisons are restricted to species or regions that have the same slope *b* in the length-weight relationship.

In the present study allometric (*Ka)* and relative (*Kn)* condition factors were used for comparison between the condition of fish species in the three studied areas of the lake: El-Boughaz, Edku-El-Bosily drains outlets and Barsik drain outlet. Statistically, ANOVA analysis revealed insignificance between the values of *Ka* of different species, either depending on areas ($F = 2.59$, $P = 0.129$) or species ($F = 1.67$, $P = 0.250$). Meanwhile, the ranges of *Kn* were found to be comparable and the averages of this factor were found to be equal 1.0 for all examined fish species. This means that fish grow in comparable manner at different areas of the lake.

According to Ricker (1975), the natural mortality is deaths from all causes, except man's fishing, including predation, senility, epidemics, pollution, etc. Asymptotic length $L\infty$ is expressing the mean length that the fish would reach if they were to grow indefinitely, while, the growth coefficient K is expressing the rate at which the asymptotic length (or weight) is approached.

In the present work, the values of $L\infty$ and K were estimated for all fish species from the length and weight data, by employing FiSAT-II software. The values of M were derived by applying the values of $L\infty$ and K in Pauly's equation (4) at average temperature 22^{o} C. Statistically, the values of M of different species were found to be significant ($F = 4.31$, $P < 0.05$), depending on areas, while, depending on species they were found to be insignificant ($F = 0.281$, $P > 0.05$). This means, regarding with statistical findings of b, r^2 and Ka that there are no differences between fish growth in different areas of lake, although at the same time, fish suffer from the stress effect of discharged effluents.

The values of M at the three studied areas were found to be high comparable with values found by Abd-Alla and Talaat (2000), except those of *O. niloticus* at Barsik Drain area (0.5843), *S. galilaeus* at El-Boughaz area (0.7404) and *O. aureus* at Barsik drain area (0.4087).

5. Conclusion

Cichlid fish species at the three studied areas at Lake Edku exhibit comparable condition, plumpness and wellbeing status. Fish do not suffer the deficiency of food and they, more or less, can tolerate the stress effect of the discharged effluents. The growth in weight is in proportional with growth in length. The LWR exhibit that fish grow in weight slightly more than that they grow in length (positive allometric growth). The lake could not be divided into polluted and non polluted areas according to the sources of the discharged wastes. The impact of discharged pollutants on fish can be exhibited by the statistical significance of the natural mortality of fish depending on the areas.

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References

Abaza, Kh. M.: 2008, Fishery status of two Cichlid fish in the main basin of Mariut Lake, 14 years after the beginning of the amelioration plan. *Egyptian Journal of Aquatic Research*, 34(4): 311-324.

Abbas, M.M.; Shakweer L.M. and Youssef, D.H.: 2001, 1. Hydro-chemical characters of Edku Lake. *Bulletin of the National Institute of Oceanography and Fisheries, A.R.E.*, 27: 65-93.

Abd-Alla, A.A. and Talaat, K.M.: 2000, Growth and dynamics of tilapias in Lake Edku, Egypt. *Bulletin of the National Institute of Oceanography and Fisheries, A.R.E.,* 26: 183-196.

Aboul-Ezz, S.M. and Soliman, A.M.: 2000, Zooplankton community in Lake Edku. *Bulletin of the National Institute of Oceanography and Fisheries, A.R.E.,* 26: 71-99.

Alsayes, A.A.: 2002, Ecological and fisheries management of Lake Edku. 7-Abundance and distribution of fish populations at Edku Lake during the year 2000. *Bulletin of the National Institute of Oceanography and Fisheries, A.R.E.,* 28: 123-156.

Anderson, R. and Neumann, R.:1996, Length, weight, and associated structural indices. in, Murphy, B.R. and D.W. Willis, editors Fisheries techniques, second edition, American Fisheries Society, Bethesda, Maryland pp. 447- 481.

Anene, A.: 2005, Condition factors of four cichlid species of a man-made lake in Imo state, Southeast, Nigeria, *Turkish Journal of Fisheries and Aquatic Sciences,* 5: 43-47.

Bagenal, T.B.: 1978, Aspects of Fish Fecundity. In: Gerking, S.D. (Ed.), Ecology of Freshwater Fish Production, Blackwell Scientific Publications. Oxford, pp: 75-101.

Bagenal, T.B. and Tesch, F.W.: 1978, Age and Growth. In: Bagenal, T. (Ed.), Methods of Assessment of Fish Production in Fresh Waters. Oxford Blackwell Scientific Publicayion, pp: 101-136.

Bolger, T. and Connolly, P. L.: 1989, The selection of suitable indices for the measurement and analysis of fish condition. *Journal of Fish Biology*, 34: 171-182.

El-Shenawy, M.A.: 2005, Prevalence and haemolytic activity of *Aeromonas* species in Lake Edku and connected drains. *Egyptian Journal of Aquatic Research,* 31 (2): 453-468.

El-Shenawy, M.A.; Farag, A.M., and El-Shenawy, M.A.: 2000, Bacteriological pollution in Lake Edku, *Bulletin of the National Institute of Oceanography and Fisheries, A.R.E.,* 26: 241-255.

Fafioye, O.O. and Oluajo, O.A., 2005. Length-weight relationships of five fish species in Epelagoon, Nigeria. *African Journal of Biotechnology*, 4(7): 749-751.

GAFRD (General Authority for Fish Resources Development), Ministry of Agriculture and Reclamation, 2009. Yearbook of fishery statistics, Technical Report, Cairo, Egypt.

Gharib, S.M.: 1998, Phytoplankton studies in Edku Lake and adjacent waters (Egypt). *Egyptian Journal of Aquatic Biology and Fisheries,* 2(1): 1-23.

Khadr, A.M.: 2005, Copper concentrations and phases in polluted surface sediments of Lake Edku, Egypt. *Egyptian Journal of Aquatic Research,* 31 (2): 253-260.

Kulbicki, M.; Guillemot, N. and Amand, M.: 2005, A general approach to length-weight relationships for New Caledonian Lagoon fishes. *Cybium,* 29: 235-252.

Kumolu-Johnson, C. A. and Ndimele, P. E.: 2011, Length-weight relationships of nine fish species from Ologe Lagoon, Lagos, Nigeria. *African Journal of Biotechnology,* 10 (2): 241-243, (Short Communication), 2011.

Le-Cren, E.D.: 1951, The Length-Weight relationship and seasonal cycle in gonad weight and condition factor in the perch (*Perca fluviatilis*). *Journal of Animal Ecology,* 20: 201-219.

Ndimele, P.E.; Kumolu- Johnson, C.A.; Aladetohun, N.F. and Ayorinde, O.A.: 2010, Length-weight relationship, condition factor and dietary composition of *Sarotherodon melanotheron,* Ruppell, 1852 (Pisces: cichlidae) in Ologe Lagoon, Lagos, Nigeria. *Agriculture and Biology Journal of North America,* 1(4): 584-590

Oni, S.K.; Olayemi, J.Y. and Adegboye, J.D.: 1983, Comparative physiology of three ecologically distinct fresh water fishes, *Alestes nurse* (Ruppell), *Synodontis schall* (Bloch), *S. schneider* and *Tilapia zilli* (Gervais). *Journal of Fish Biology,* 22: 105-109.

Orhan, A.k.; Sebahattin Kutlu and Ilhan Aydın: 2009, Length-Weight Relationship for 16 Fish Species From the Eastern Black Sea, Turkiye. *Turkish Journal of Fisheries and Aquatic Sciences* (Short Paper), 9: 125-126.

Pauly, D.: 1983, Some simple methods for the assessment of tropical fish stocks. FAO Fisheries Tech. Pap., FAO. Rome, 234: 52.

Ricker, W.E.: 1973, Linear regression in fisheries research. *Journal of Fisheries Research Board of Canada,* 30: 409-434.

Ricker, W. E.: 1975, Computation and Interpretation of Biological Statistics of Fish Populations. *Bulletin of Fisheries Research Board of Canada,* 191: 382.

Salah, M.M.: 1960, The phytoplankton of Mariut Lake and Edku Lake with a general contribution to the Halobion system. *Hydrobiology Department, Alexandria Institute of Hydrobiology,* Notes and Memoires N^o 57, 15pp.

Salah, M.M.: 1961, Biological productivity of Mariut Lake and Edku Lake. *Hydrobiology Department, Alexandria Institute of Hydrobiology,* Notes and Memoires N^o 63, 35pp.

Shakweer, L.M.: 2006, Impacts of drainage water discharge on the water chemistry of Lake Edku. *Egyptian Journal of Aquatic Research,* 32(1): 264-282.

Shakweer, L.M. and Abbas, M.M.: 2005, Effect of ecological and biological factors on the uptake and concentration of trace elements by aquatic organisms at Edku Lake. *Egyptian Journal of Aquatic Research,* 31(1): 271-278.

Shriadah, M.M.A. and Tayel, F.T.R.: 1992, Impact of industrial, sewage and agricultural effluents on Lake Edku and Abu-Qir Bay, Egypt, *Bull. Fac. Sc. Alex. Univ.,* 32 (A): 130-155.

Soliman, A.M.: 2005, Zooplankton structure in Lake Edku and adjacent waters, Egypt. *Egyptian Journal of Aquatic Research,* 31(2): 239-252.

Tesch, W.: 1971, Age and growth. In: RICKER, W.E., (ed), Methods for assessment of fish production in fresh waters, 2nd edn. International Biological Programme, Oxford and Edinburgh, 99-130.

Youssef, D.H. and Masoud, M.S.: 2004, Behavior of some acid-base indicators in some Egyptian aquatic environments. *Bulletin of the Chemists and Technologists of Macedonia,* 23(1): 37- 46.

Zaghloul, F.A. and Hussein, N.R.: 2000, Impact of pollution on phytoplankton community structure in Lake Edku, Egypt. *Bulletin of the National Institute of Oceanography and Fisheries, A.R.E.,* 26: 297-318.

تأثير مخلفات الصرف على حالة أسماك البلطى فى بحيرة إدكو- مصر

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تم جمع عد د 1011 ، 959 ، 830 من أسماك البلطى النيلى ، الأخضر ، الجاليلى و الحسانى من ثلاث مناطق : منطقة البوغاز ، منطقة مصبات مصرفى إدكو و البوصيلى و منطقة مصب مصرف بارسيق شمال و شرق ووسط بحيرة إدكو خلال الفترة من 2001- 2003 . تم حساب العلاقة بين الطول و الوزن لجميع أنواع الأسماك فى الثلاث مناطق تحت الدراسة ، و قد وجد ارتباط قوى بين الطول و الوزن لجميع أنواع الأسماك حيث أن قيم معامل الارتباط r^2 قريبة جدا من الواحد الصحيح كما أنها ذات معنوية إحصائية عند المستوى 0.05 . كما أن قيم الميل b تزيد عن 3 بمعنوية إحصائية عند المستوى 0.05 . و قد وجد أن متوسطات معامل الحالة Ka لأسماك البلطى النيلى 1.4 , 1.3 , 1.0 و لأسماك البلطى الأخضر 1.3 , 1.4, 1.3 و لأسماك البلطى الجاليلى 1.5 , 1.4 , 1.3 و لأسماك البلطى الحسانى فى المناطق الثلاث تحت الدراسة . إحصائيا وجد أن متوسطات معامل الحالة غير معنوية سواء بالنسبة لأنواع الأسماك أو بالنسبة إلى مناطق الدراسة الثلاث . كما وجد أن متوسطات معامل الحالة Kn لجميع أنواع الأسماك فى مناطق الدراسة الثلاث تساوى الواحد الصحيح . و قد وجد أن متوسط معامل الوفاة الطبيعية M 0.7481 , 1.1058 , 0.5843 لأسماك البلطى النيلى و 1.2379 , 1.1122 , 0.8786 و لأسماك البلطى الأخضر و 0.7404 , 1.3506 , 1.0446 لأسماك البلطى الجاليلى و 0.9786 , 2.0558 , 0.4087 لأسماك البلطى الحسانى . إحصائيا وجد أن قيم معامل الوفاة الطبيعية معنوية بالنسبة لمناطق الدراسة الثلاث وغير معنوية بالنسبة لأنواع الأسماك عند المستوى 0.05 .

من هذه النتائج يمكن استخلاص ما يلى :

1- أسماك البلطى بأنواعها الأربعة فى بحيرة إدكو تنمو فى الوزن بالتناسب مع النمو فى الطول , و إن كان النمو فى الوزن يزيد قليلا عن النمو فى الطول .
2- لا يوجد اختلاف فى حالة الأسماك بأنواعها الأربعة بين منطقة و أخرى من مناطق الدراسة الثلاث بتأثير صرف المخلفات من الشرق أو من الجنوب .
3- بحيرة إدكو لا تنقسم إلى مناطق ملوثة و أخرى غير ملوثة بتأثير صرف المخلفات فيها .
4- يتضح تأثير صرف المخلفات فى البحيرة من زيادة نمو الأسماك فى الوزن عن الزيادة فى الطول, وإن كانت هذه الزيادة بنسب قليلة , و كذلك من معنوية معامل الوفاة الطبيعية للأسماك بالنسبة لمناطق الدراسة الثلاث .