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An Experimental Trammel Net in the River Nile, Aswan, Egypt Influencing the Age and Growth of the Nile tilapia *Oreochromis niloticus* (Linnaeus, 1758)

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ABSTRACT

Oreochromis niloticus, a widely distributed and commercial fish in Egypt, needs continuous updating and studying. The current work aimed to study the length-weight relationship, condition factors, age and growth of *O. niloticus* and the effect of fishing gear on fish stocks. A total of 608 *O. niloticus* specimens were collected by three modified trammel nets with different mesh sizes (56, 64 and 76 mm) in percentages of about 49.8%, 47.4% and 2.8%, respectively. Total length (TL) ranged from 12 to 24.3cm, and total weight ranged from 42.8 to 253g for all samples. The exponent "b" of the length-weight relationships was "3" for females (b = 2.79), males (b = 2.69) and all samples (b = 2.66), reflecting the negative allometric mode of growth. The highest condition factors were found in February for females and January for males and combined sexes, and all values were >1.0. The age of *O. niloticus* was determined to be 4 years old. Von Bertalanfi's growth constants are L = 28cm; K = 0.28 y-1, and to = -1.9. Regarding the age differences with variation in mesh sizes, it has been pointed out that the use of a median and large mesh sizes is important to avoid small fish in a lower age group, which is considered for fisheries management and conservation.

INTRODUCTION

The inland fisheries of the River Nile are important fish production resources in Egypt. They include many important fish species such as tilapia species, *Lates niloticus* and others **(AbouelFadl & Farrag, 2020)**. The fishing industry has a relatively minor direct role in the economy of Egypt. In Egypt, the River Nile extends for about 1600km long, with two major branches of downstream, which discharge to the Mediterranean Sea. The River Nile fishery production is currently around 77732 tons, representing approximately 19.48% of the nation's total fish production (**GAFRD, 2019)**. In recent years, the recorded fisheries catch of the River Nile basin in Egypt have decreased from 110,000 in 2001 to 77,732 tons in 2017, with tilapia (composed of four different species *Oreochromis niloticus*, *O. aureus*, *Coptodon zillii* and *Sarotherodon galilaeus*) accounting for more than 30% of the total production **(Aly and Shalloof, 2019)**. *Oreochromis niloticus* is considered Egypt's most popular fish species due to its productivity and demand **(GAFRD, 2019)**. In Egypt, various aspects of the biology and fisheries of *O. niloticus* have been studied by different authors (**El-Bokhty, 2006; Mahmoud & Mazrouh, 2008; Authman *et al*., 2009; Shalloof and El-Far, 2009; Hassan and El-Kasheif, 2013; El-Kasheif *et al*., 2015; Khallaf *et al*., 2018**)

Artisanal or small-scale fisheries are important in the whole world, contributing about half of the landings used as human food and employing about 90% of the world's fishermen **(McGoodwin, 1990; FAO, 2003)**. In Egypt, trammel nets and gillnets are both frequently utilized in the freshwater fisheries; however, the trammel net can capture both small and large fish, therefore it has greater efficiency than the gillnet **(Koike and Matuda, 1988**). Trammel nets are passive walls of netting that operate by wedging or entangling fish swimming into them **(Saber *et al*, 2020)**. The efficiency of fishing gears is usually modified to catch certain species and certain sizes in certain conditions; hence, the species diversity and biological behavior may be changed or affected by the fishing nets and their characteristics.

The impact of environmental changes on the survival and growth of fish can be explained by analyzing age groups. Estimating the age of a stock is an important resource for effective management of commercial species, and the size assessment at the beginning of sexual maturity is particularly important for understanding the reproductive strategies and reproductive efficiency of a species **(Farrag *et al*., 2018; Mehana *et al*., 2018; Lolas and Vafidis, 2021)**. Other measures related to growth and aging that may be influenced also by the fishing gear are the length-weight relationship and conditions **(Anene, 2005; Abowei *et al*., 2009; Ogunola *et al*., 2018)**.

The length–weight relationship is the most relevant aspect of population dynamics and stock assessment studies and in the development of strategies for sustainable fisheries management **(Froese, 2006; Froese *et al*., 2011; Karuppiah *et al*., 2021)**. The condition factor is a useful index for estimating growth and assessing the environmental quality **(Olopade and Tarawallie, 2014)**. Given the importance of the national species *O. niloticus* in Egypt, it is necessary to address and update its fisheries status or its data setting in newly areas relating to certain fishing gears. The current study aimed to determine the age and growth of the Nile tilapia from the River Nile, Aswan, Egypt with respect to its modified fishing gear.

MATERIALS AND METHODS

Study Area

The study area was conducted in the River Nile in Aswan city (Lat. 24° 2'4.68"N to Lat. 24°11'35.14"N). It is a narrow region and extends for about 18.6 Kilometers long (Fig. 1). The floor structure of the fishing ground is muddy and rocky.

Samples collection

The specimens of the Nile tilapia *O. niloticus* were collected monthly from December 2020 to November 2021 using an experimental trammel net. All samples were collected from four stations (Ferial, Elmahata, Aboelrish and Bahreef) to cover the studied area. The sampling was carried out by small fishing vessels (symbok) without engines while working by paddle. A total of 608 specimens of *O. niloticus* were caught by modified nets and measured to the nearest 0.1cm for TL (distance from the tip of snot to the end of the caudal fin), weighed to the nearest 0.1g for total weight, and dissected for sex determination, gutted weight, liver weight & gonad weight.

Fig. 1. Satellite images showing the location of study in the River Nile in Aswan city, Egypt

Growth measurements

Length-Weight relationship

The length-weight relationship was described by the equation $W=aL^b$, where W is the body weight; L is the total length; b stands for the growth exponent or length-weight factor, and a represents a constant. **(Le Cren, 1951)**

Absolute and relative condition factor

The absolute condition factor was calculated according to the equation of **Bagenal and Tesch (1978):**

$$K = W / L^3 \text{ X } 100$$

Where, W is fish body weight (g), and L is fish total length (cm).

Based on the formula of **Le Cren (1951)**, the relative condition factor "Kn" was calculated in order to compare conditions between species within their size classes. Kn= W/W' Where, W is fish body weight (g), and W' = aL^b (calculated weight).

Age determination

The otoliths of the samples were used to determine the age. In the laboratory, both sagittas were removed from each fish sample. Otoliths were then washed in water and cleaned from all extraneous tissue, dried, labeled and stored in plastic vials. Digital images were obtained using a camera (ABBOT DEC 2000) mounted on a binocular stereomicroscope (Zeitess 530) for each pair of otoliths, dipped in 50% glycerol and illuminated with oblique reflected light. The clearest image was chosen for interpretation **(AbouelFadl *et al*., 2020)**. Aging precision between readers was estimated by calculating the percent agreement between three independent readers, and the coefficient of variation (CV) is shown in Fig. (2), **(Kimura and Lyons, 1991)**.

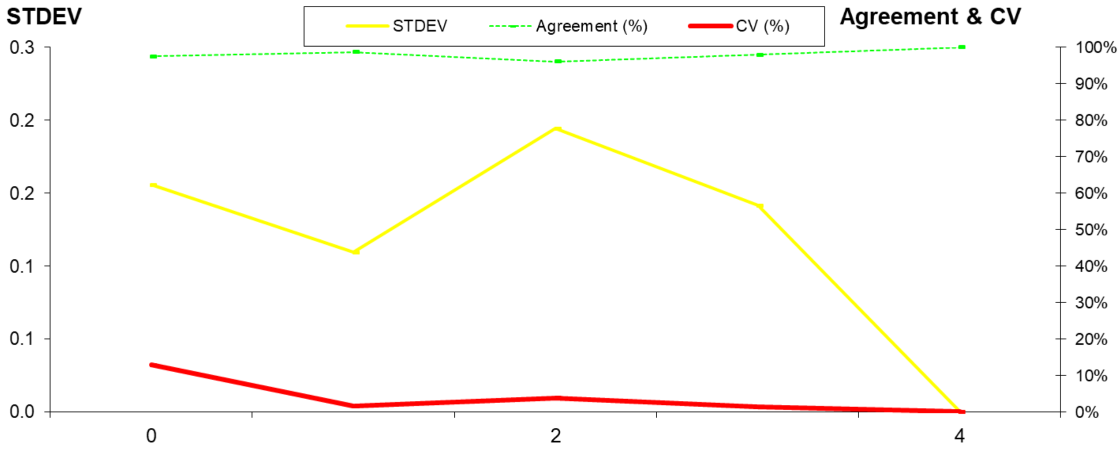

Fig. 2. The coefficient of variation, agreement, and the standard deviation in age estimation by readers

Von Bertalanffy growth parameters

The theoretical growth of *O. niloticus* was described using the **von Bertalanffy (1938)** growth model. The length-at-age data of *O. niloticus* from otolith reading was fitted by using non-linear least-squares conducted through FiSAT II software (**Gayanillo *et al*., 1997)** to estimate the von Bertalanffy growth parameters (L∞, K and to) considering the von Bertalanffy equation: $Lt = L\infty\ [1 - e^{-k(t-to)}]$, where Lt is the length at age t; L∞ is the asymptotic length of fish; K is the growth coefficient, and t_o is the age at which the length is theoretically zero.

Growth performance index (Ø) and maximum age (tmax)

Using **Pauly and Munro's (1984)** model, the growth performance index of *O. niloticus* was calculated as follows: $\phi = \log K + 2 \log L1$.

Longevity (t_{max}) was estimated according to **Pauly's (1980)** equation: $t_{max} = 3/K + to$, where K is the growth coefficient in the von Bertalanffy growth equation. The presented data were statistically analyzed using Microsoft Excel, while other fisheries statistics and outputs were applied by using fisheries program as FiSAT II.

RESULTS

1. Experimental fishing by trammel nets

In most fishing from the River Nile in Aswan city, a trammel net is used, with three of modified trammel nets of 56 mm, 64 mm and 76 mm mesh size and the same twine diameter of 0.13 mm in the inner layer and 152.4 mm for out layer, in addition to a twine diameter of 0.21 mm and a fixed hanging ratio of 0.51 (Fig. 3). During this experiment, the nets were used by small fishing boats (symbok). A total of 608 specimens were caught in three designed trammel nets. The sample percentages were 49.8% by net with a mesh size of 56mm, while 47.8% by net with a mesh size of 64mm and 2.8% for another net (76 mm).

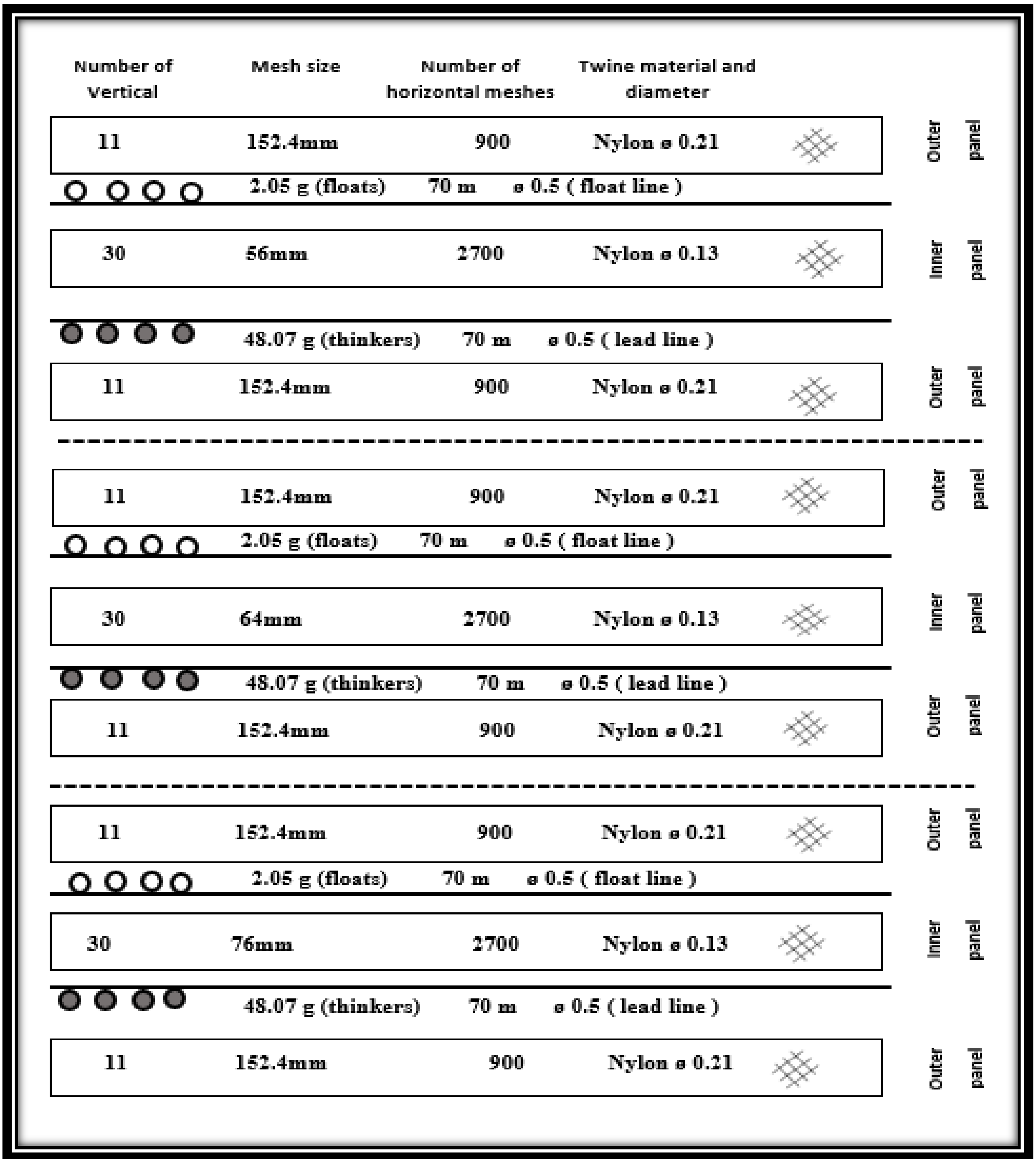

Fig. 3. Specifications of modified trammel nets used in fishing operations

2. Length-Weight relationship

The total length of all samples ranged from 12 to 24.3cm, with an average of 16.64 ± 1.73cm, and the total weight ranged from 42.8 to 253g, with an average of 90.99 ± 28.09g. The male size ranged from 12 to 22.7cm, with an average of 16.8 ±1.57 cm. In females, the size ranged from 12.2 to 24.3cm, with an average of 16.2 ±2.04 cm (Table 1). The length weight relationship of *O. niloticus* from the River Nile in Aswan city was estimated using total length and total weight. The result showed that the exponent b was < "3" for males (b = 2.68), females (b = 2.79), and all samples (b = 2.67), exhibiting a negative allometric mode of growth for all categories (Table 1 & Fig. 4).

Table 1. Length- weight relationship of *O. niloticus* from the River Nile, Aswan city during 2021

Sex	No.	Total length (cm)			Total weight (g)			a	B	r2
		Min	Max	Mean	Min	Max	Mean			
Males	470	12	22.7	16.83	43.5	226	92.2	0.044	2.694	0.87
Females	138	12.2	24.3	16.25	52.6	253	90.86	0.036	2.791	0.94
C. sexes	608	12	24.3	16.63	43.5	253	90.99	0.049	2.663	0.89

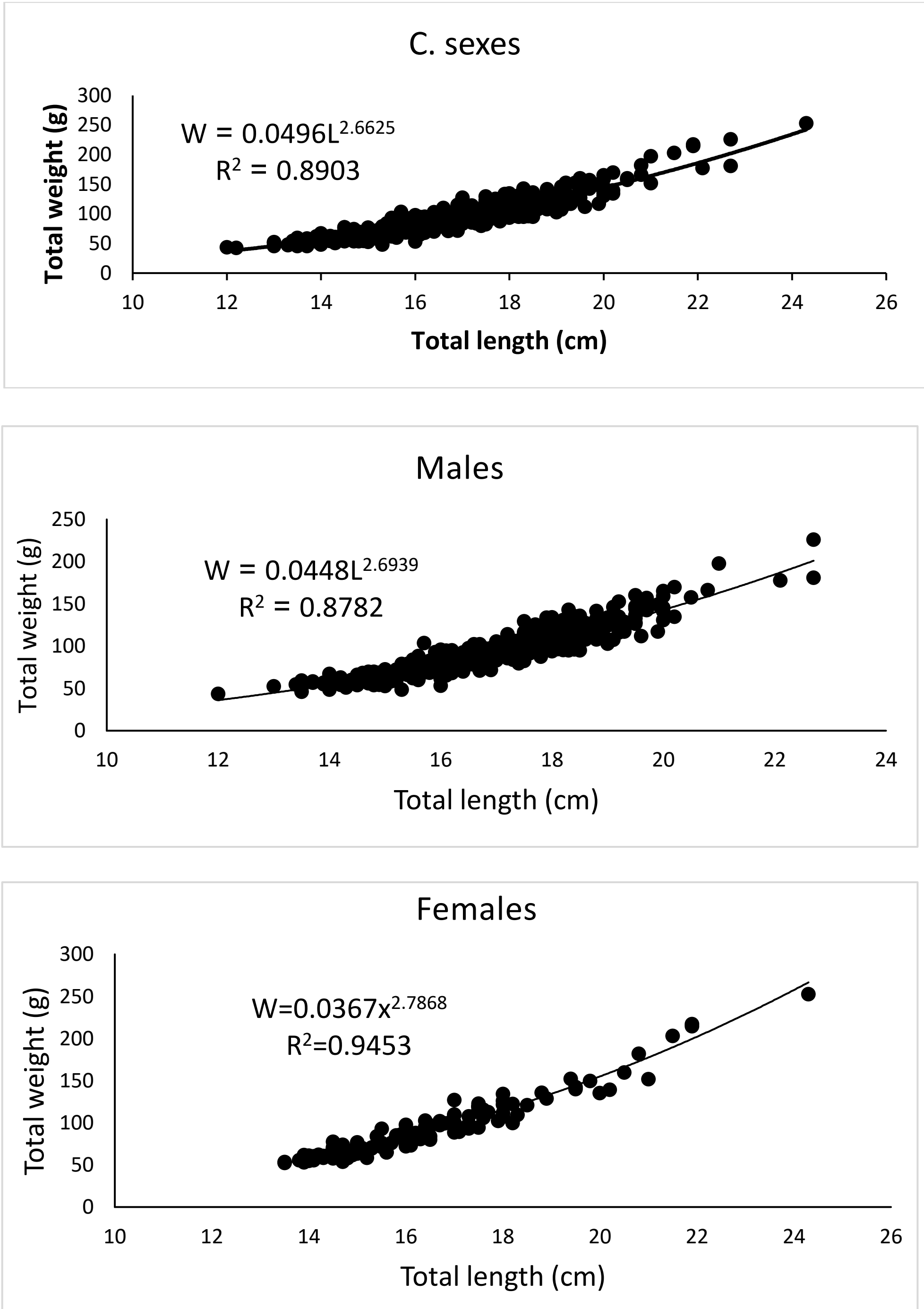

Fig. 4. Length- weight relationship for C. sexes, males and females of *O. niloticus*

3. Condition factor (Coefficient of condition)

The monthly absolute condition factor (Kc) values of C. sexes, males, and females of *O. niloticus* are represented in **Fig. (5).** The annual average of the absolute conditions (Kc) was 1.7 ± 0.048, 1.68 ± 0.057 and 1.74 ± 0.059 for C. sex, males and females respectively. The relative conditions (kn), were 1.005± 0.03, 0.997± 0.034 and 1.025± 0.0322 as annual values for C. sexes, males and females, respectively (Fig. 6). The highest Kc values were found in February for females and in January for males and C. sexes. The lowest Kc values were recorded in June for males and C. sexes, while the lowest value was registered in September for females.

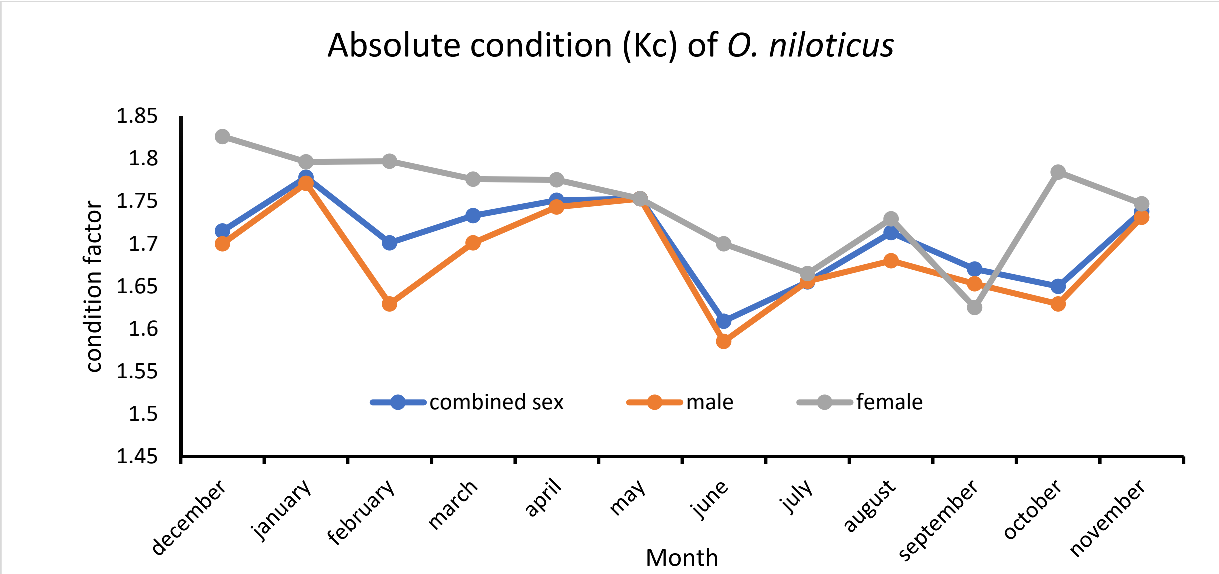

Fig. 5. Monthly average absolute condition factor for the C. sexes, males and females of *O. niloticus*

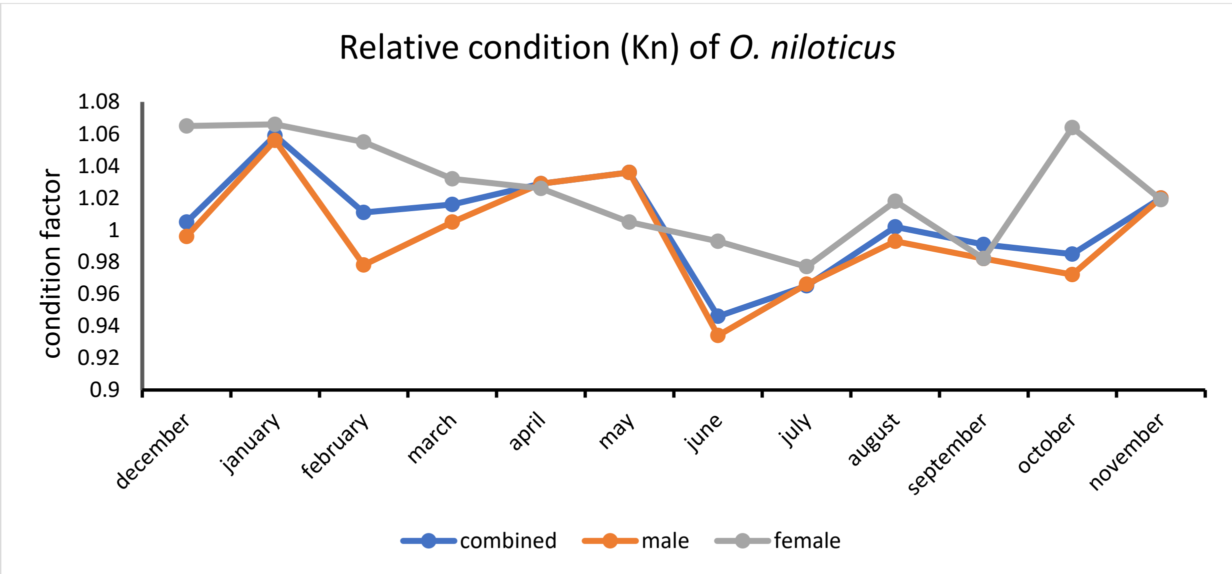

Fig. 6. Monthly average relative condition factor for the C. sexes, males, and females of *O. niloticus*

4. Age determination

Based on otolith reading (Fig. 7), the life span of *O. niloticus* was estimated as five age groups in four years old. The mean lengths at the end of each year of life for all samples (C.

sexes) were 14, 16.21, 17.22, 19.26 and 20.58cm for the 0, 1st, 2nd, 3rd and 4th years of life, respectively. It was found also that, fish of age-group 1 was dominant in the catch and constituted about 59.5%. While, the frequency of fishes of age-groups 4 was the least and contributed about 2.6%. Mean lengths and increment for each age group of *O. niloticus* are presented in Table (4). The growth in length and annual increment are displayed in Fig. (8).

Table 4. The mean length at the end of each year and the number of samples in each age group

Age	No. of Fish	Mean length	%	Increment
0	54	14.0	8.8%	14
1	362	16.21	59.5%	2.21
2	144	17.92	23.7%	1.71
3	32	19.26	5.3%	1.34
4	16	20.58	2.6%	1.32

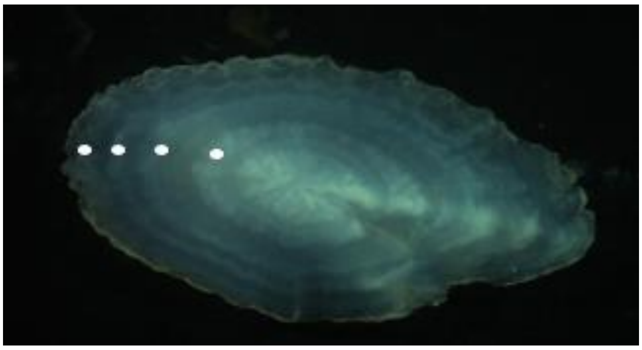

Fig. 7. Sagittal otolith of *O. niloticus* from the River Nile IN Aswan city (a 24.3 cm TL; 4 year)

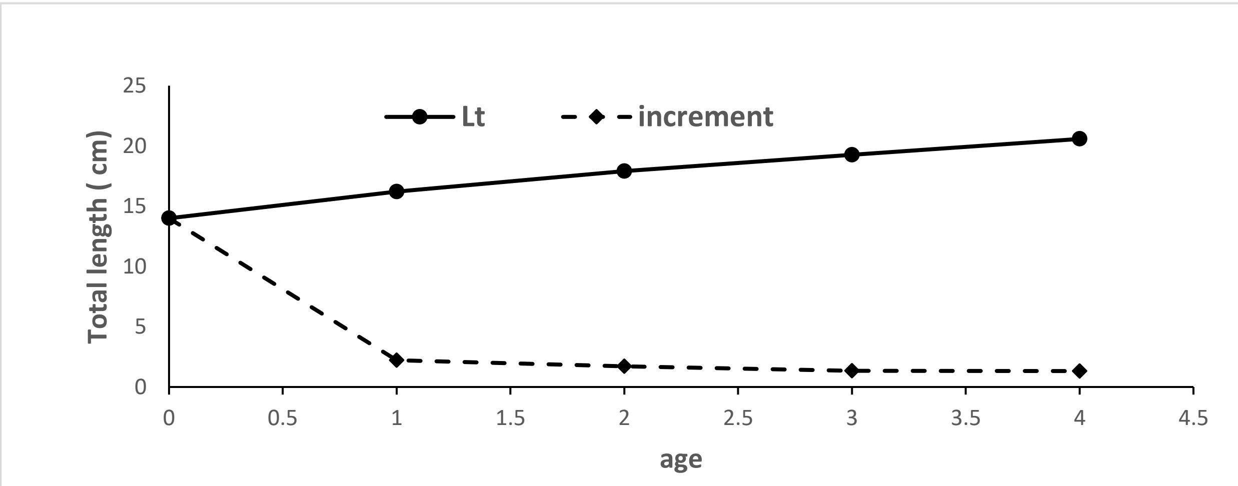

Fig. 8. Growth curve in lengths and annual increment of *O. niloticus*

5. Growth parameters, growth performance index (Ø) and the maximum age (tmax)

The growth parameters were adjusted by using the VBGF mounted to length-at-age data based on non-linear least-squares, which revealed that $L\infty$ = 28 cm (SE = 1.85 and C.V. = 0.066); K = 0.28 year-1 (SE = 0.051 and C.V. = 0.183), and to = -1.9. The von Bertalanffy equation was rewritten as $Lt = 28[1 - e^{-0.28(t-1.9)}]$, and the growth curve is shown in Fig. (9). The growth performance of *O. niloticus* recorded a value of 2.10, and the potential longevity (t_{max}) was 8.8 y.

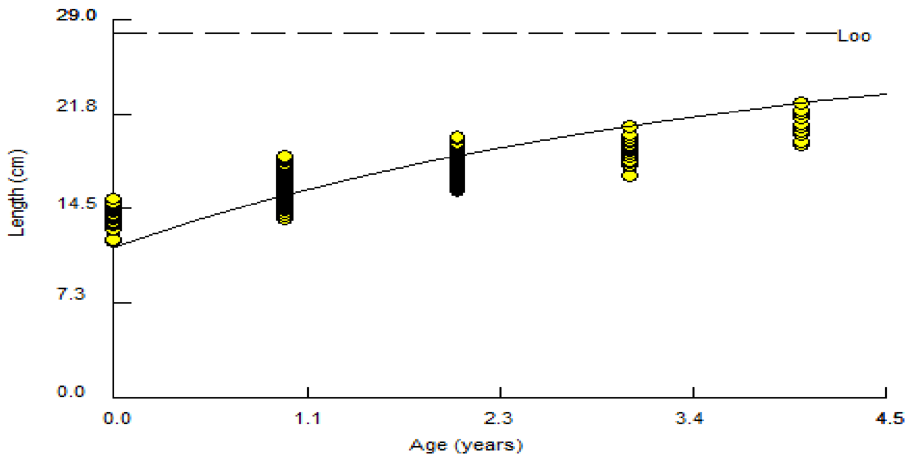

Fig. 9. Growth curve estimated from length-at-age data of *O. niloticus*

6. Aging relative to difference in mesh size of fishing gear

The estimated lifespan of *O. niloticus* was four years for the total population. According to the fishing gears tested in different mesh sizes, the first fishing net had a mesh size of 56mm, giving us fishes ranging in length from 12 to 24cm, with an age group from 0 to 4 year, and the 1st age group was the dominant in this net. The second fishing gear which had a mesh size of 64 mm caught the specimens of 14 to 24cm in length, with age groups of 0 to 4 years similar to the previous one, and also the 1st age group was the dominant in this net. While, the third experimented fishing net with its largest mesh size (76mm) gave us fishes ranging in length from 18 to 24 cm, with age groups from 2 to 4 year. It was noticed that, the 3rd age group was the dominant in this net (Fig. 10). Generally, the present study illustrated that, the length range of fishes increased with the increase in mesh size combined with the absence of smaller sized fishes for the bigger mesh size. This led to the absence of a lower age group in the larger mesh size.

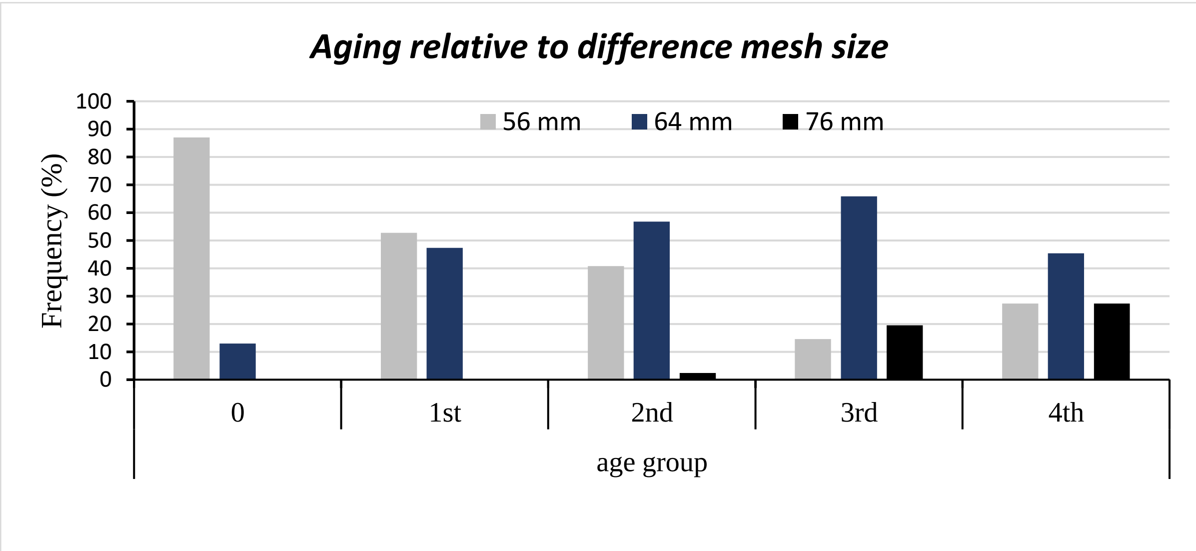

Fig. 10. Aging relative to difference in mesh size of fishing gear

DISCUSSION

The length-weight relationship in fish is an essential biological parameter, providing information useful for the conservation of natural populations and for fisheries management **(Froese, 2006; Karuppiah *et al*., 2021)**. The slope "b" of the length-weight relationship is an indicator of the variation in fish condition and health **(Le Cren, 1951; Ricker, 1975)**. In addition, it may vary with species, sex or geographical areas. In the present study, the "b" value was less than “3,” giving a negative allometric mode of growth for males, females and all samples. Different results of *O. niloticus* from several areas are shown in Table (6). All studies indicate a negative allometric growth for *O. niloticus* in agreement with the present study on populations of *O. niloticus* in the River Nile.

The condition factor is an index that expresses the degree of well-being, relative strength and interactions between abiotic and biotic factors in fish physiological conditions **(Froese, 2006; Famoofo and Abdul, 2020)**. The condition factor of 1.0 or greater indicates the good condition of fish, while less than 1.0 shows non- satisfied condition **(Ogunola *et al*., 2018; Farrag *et al*., 2022)**. In the present study, the mean values of the condition factor for males, females and C. sexes for *O. niloticus* were all > 1.0, indicating that the fish were in good condition in accordance with the findings of **Le Cren (1951)** and **Panicker and Katchi, (2021)**. High conditions imply that the fish are in good condition and vice versa **(Quarcoopome, 2017)**. The average of condition factor in this study was 1.7, which is equal to the value recorded in the study of **Shalloof and El-Far (2009)** on Abu-Zabal lakes. Whereas, it is less than that of **Khallaf *et al* (2018)** in Bahr Shebeen and Khadraweya canals and the value reported in the work of **El-Kasheif *et al*. (2015)** conducted on El-Bahr El- Faraouny canal. Furthermore, the present value of the average condition factor is more than that of **Hassan and El-Kasheif (2013)** recorded for the River Nile. Hence, it can be deduced that, the grand average values of the condition of *O. niloticus* in the River Nile in Aswan city coincide with those estimated by different authors for the same species while differing from others **(Lowe-McConnell, 1975; Sindermann, 1979; Lowe-McConnell, 1987; Sindermann, 1990)**.

The present life span of *O. niloticus* was determined by otolith and reached to 4 years for 24.3cm TL. The maximum recorded age differed by location (Table 6). It reached 7 years for fish individual TL of 31.50 cm collected from Nozha Hydrodrome **(Mahmoud *et al*., 2013)**, 4 years for those with 22cm TL from Abu-Zabal lakes **(Shalloof and El-Far, 2009),** 4 years for those with 28.5cm TL from the River Nile at Beni Suef Governorate **(Hassan and El-Kasheif 2013)**, 6 years for 33.6 cm TL from in El-Bahr El- Faraouny Canal **(El-Kasheif *et al*., 2015)**, 4 years for those with 30 cm TL from Bahr Shebeen **(Khallaf *et al*., 2018)**, 4 years for fish TL of 23 cm from Khadraweya canal **(Khallaf *et al* 2018)**, 7 years at 40.5 cm TL from Lake Tana **(Assefa *et al*., 2019)** and reached 4 years for those with 24.3cm TL in the present study. Table (6) illustrates that the present study in addition to the studies of **Shalloof and El-Far (2009)**, **Hassan and El-Kasheif (2013)** and **Khallaf *et al* (2018)** reported a lower life span, compared those reported in other areas. This might be due to the lower length range used for the samples. However, the lower length range combined with lower life span indicated that the River Nile in Aswan city is in bad status

The von Bertalanffy growth parameters of *O. niloticus* were calculated and compared to those adjusted in other studies covering different localities and periods (Table 6). The asymptotic length L∞ of *O. niloticus* in this study was 28cm. Thus, the present value is close to those recorded in the studies of **Tharwat *et al*. (1997)** in the River Nile (Cairo sector) and **El-Sehamy (1993**) in the River Nile (Bahr Shbeen). While, it was lower than the values obtained in the works of **Khalifa *et al*. (2000)** in Lake Nasser, **Authman *et al*. (2009)** in Damietta branch, **Shalloof and El-Far (2009)** in Abu-Zabal Lakes, **Hassan and El-Kasheif (2013)** in the River Nile, **Mahmoud *et al*.(2013)** in Nozha Hydrodrome, **El-Kasheif *et al*. (2015)** in El-Bahr El- Faraouny canal, **Tesfaye and Wolff (2015)** in Lake Koka, Ethiopia, **Yongo and Outa (2016)** in Lake Victoria, **Khallaf *et al*. (2018)** in Bahr Shebeen canal and Khadraweya canal, and **Assefa *et al*. (2019)** in Lake Tana. This may be attributed to the difference in size of the collected samples and the difference in the ecological environment of different habitats.

The present growth coefficient (K) of *O. niloticus* recorded in this study was 0.28, lower than the values reported in **El-Sehamy (1993**) for the River Nile Bahr Shbeen, **Tharwat *et al*. (1997)** with respect to the River Nile, Cairo, the study of **El-Kasheif *et al*. (2015)** on El-Bahr El- Faraouny Canal, **Tesfaye and Wolff (2015)** on Lake Koka, Ethiopia, **Yongo and Outa (2016)** on Lake Victoria and **Assefa *et al*. (2019)** conducted on Lake Tana. On the other hand, the current value is higher than those recorded in the study of **Khalifa *et al*. (2000)** on Lake Nasser, **Authman *et al*. (2009)** on the Damietta branch, **Shalloof and El-Far (2009)** on Abu-Zabal lakes, **Hassan and El-Kasheif (2013)** on the River Nile, **Mahmoud *et al*. (2013)** for the Nozha Hydrodrome, and **Khallaf *et al*. (2018)** addressing Bahr Shebeen canal and Khadraweya canal. This variation may be attributed to the difference of method of data collection, size of collected samples and difference of study area which result in difference in ecological environment.

On the other hand, growth performance indices were calculated to compare fish species in different localities and/or other species in the same area **(Pauly & Munro, 1984)**. They are the most accurate indicators of a fish species' overall growth performance **(Moreau *et al*., 1986)**. From the comparison set with those from previous studies (Table 6), it was concluded that the River Nile in Aswan city fishing ground is the worst for *O. niloticus* growth than that reported in the study of **El-Sehamy (1993**) with respect to the River Nile of Bahr Shbeen, **Tharwat *et al*. (1997)** regarding the River Nile, Cairo sector, **Authman *et al*. (2009)** addressing the Damietta branch, **Shalloof and El-Far (2009)** examining Abu-Zabal Lakes, **Hassan and El-Kasheif (2013)** conducted on the River Nile, **Mahmoud *et al*. (2013)** in Nozha Hydrodrome. This is also the perceptive when the status of the current studied area was compared to the following studies: **Khalifa *et al*. (2000)** in Lake Nasser, **El-Kasheif *et al*. (2015)** in El-Bahr El- Faraouny Canal, **Tesfaye and Wolff (2015)** in Lake Koka, Ethiopia, **Yongo and Outa (2016)** in Lake Victoria, **Khallaf *et al*. (2018)** in Bahr Shebeen canal and Khadraweya canal, and **Assefa *et al*. (2019)** in Lake Tana. This status reveales the general stress posed on fish population of that species in the River Nile, Aswan city.

Longevity t_{max} for *O. niloticus* was 8.8 y, longer than that of **Assefa *et al*. (2019)** in Lake Tana and shorter than the findings of **El-Sehamy (1993)** in River Nile (Bahr Shbeen), **Tharwat *et al*. (1997)** in the River Nile (Cairo sector**)**, **Khalifa *et al*. (2000)** in Lake Nasser, **Authman *et al*. (2009)** in Damietta branch, **Shalloof and El-Far (2009)** in Abu-Zabal Lakes, **Hassan and El-Kasheif (2013)** in the River Nile, **Mahmoud *et al*. (2013)** in Nozha Hydrodrome, , , **El-Kasheif *et al*. (2015)** in El-Bahr El- Faraouny Canal, **Tesfaye and Wolff (2015)** in Lake Koka, Ethiopia, **Yongo and Outa (2016)** in Lake Victoria as well as those recorded in the study of **Khallaf *et al*. (2018)** conducted on the status of Bahr Shebeen canal and Khadraweya canal.

Information on the size selectivity of the fishing nets are essential to properly regulate their use and for fisheries management. The major objective of the selectivity is to estimate the optimum mesh size, which increases the proportion of the targeted species and to reduce the discards and by-catch for achieving sustainable fishing **(Fabi *et al*., 2002; Saber *et al*., 2020)**. In the present study, it was found that the length distributions of *O. niloticus* fished with the three different mesh size of trammel nets (56, 64 and 76 mm) are shifted to the right, increasing the mean length of the entangled fishes by increasing mesh size, thus improving the selectivity of the net. These findings agree with those of **Fabi *et al*. (2002)**, **El-Bokhty (2017)**, **Saber *et al*. (2020)** and **Saber and Aly (2022)** (Table 5). The captures progressively drifted towards the highest length classes when the mesh size was increased, subsequently the fish's age drifted towards the highest age group.

Table 5. Variations in fish length caught by trammel net with different mesh sizes from various regions

<table>
<tr><th>Author</th><th>Region</th><th>Species</th><th>Mesh size(mm)</th><th>Mean length (cm)</th></tr>
<tr><td rowspan="9">Fabi et al. (2002)</td><td rowspan="9">Central Adriatic sea and southern Ligurian Sea</td><td rowspan="9">Lithognathus mormyrus, Diplodus annularis and Mullus barbatus</td><td rowspan="3">45</td><td>17.4 ± 2.4 for L. mormyrus</td></tr>
<tr><td>13.1 ±2.2 for D. annularis</td></tr>
<tr><td>16.2 ± 2.1 for M. barbatus</td></tr>
<tr><td rowspan="3">70</td><td>25.6 ±4.1 for L. mormyrus</td></tr>
<tr><td>17.3 ± 3.3 for D. annularis</td></tr>
<tr><td>15.4 ± 1.3 for M. barbatus</td></tr>
<tr><td rowspan="3">90</td><td>26 ± 6.5 for L. mormyrus</td></tr>
<tr><td>11.7 ± 3.6 for D. annularis</td></tr>
<tr><td>14.9 ± 1.0 for M. barbatus</td></tr>
<tr><td rowspan="3">El-Bokhty (2017)</td><td rowspan="3">Lake Manzalah, Egypt</td><td rowspan="3">Oreochromis niloticus</td><td>42.8</td><td>10.87</td></tr>
<tr><td>49.4</td><td>12.54</td></tr>
<tr><td>57.2</td><td>14.53</td></tr>
<tr><td rowspan="6">Saber et al. (2020)</td><td rowspan="6">Gulf of Suez, Egypt</td><td rowspan="6">Pomadasys stridens and Gerres oyena</td><td rowspan="2">34</td><td>10.6 for P. stridens</td></tr>
<tr><td>11 for G. oyena</td></tr>
<tr><td rowspan="2">37</td><td>12.4 for P. stridens</td></tr>
<tr><td>12.9 for G. oyena</td></tr>
<tr><td rowspan="2">40</td><td>13.6 for P. stridens</td></tr>
<tr><td>13.9 for G. oyena</td></tr>
<tr><td rowspan="8">Saber and Aly, (2022)</td><td rowspan="8">Lake Nasser, Egypt</td><td rowspan="8">O. niloticus and Sarotherodon galilaeus</td><td rowspan="2">83</td><td>23.3 ± 4.1 for O. niloticus</td></tr>
<tr><td>20.1 ± 3.0 for S. galilaeus</td></tr>
<tr><td rowspan="2">95</td><td>27 ± 6.3 for O. niloticus</td></tr>
<tr><td>25.4 ± 4.3 for S. galilaeus</td></tr>
<tr><td rowspan="2">108</td><td>32 ± 5.8for O. niloticus</td></tr>
<tr><td>28.6 ± 3.0 for S. galilaeus</td></tr>
<tr><td rowspan="2">120</td><td>38 ± 6.9 for O. niloticus</td></tr>
<tr><td>30.1 ± 2.2 for S. galilaeus</td></tr>
<tr><td rowspan="3">Present study</td><td rowspan="3">River Nile in Aswan city, Egypt</td><td rowspan="3">O. niloticus</td><td>56</td><td>15.5 ± 1.6</td></tr>
<tr><td>64</td><td>17.5 ± 1.4</td></tr>
<tr><td>76</td><td>20.2 ± 1.3</td></tr>
</table>

Table 6. Condition factor (Kc), length–weight relationship equations, von Bertalanffy growth parameters (K, $L\infty$, t_o, ϕ and t_{max}) of *O. Niloticus* from various regions by various authors.

Author	Region	Sex			Age	Kc	Length rang (cm)	Length–weight relationship equation	r^2	Growth parameters			ϕ	t_{max}
		male	female	combind						$L\infty$	K	t_o		
El-Sehamy (1993)	Bahr Shbeen (Egypt)	---	---	---	---	---	---	---	---	29.33	0.37	---	2.76	---
Tharwat *et al*. (1997)	River Nile Cairo sector (Egypt)	---	---	---	---	---	---	---	---	28.56	0.49	---	2.61	---
Khalifa *et al.* (2000)	Lake Nasser (Egypt)	---	---	---	---	---	---	---	---	54.730	0.270	-0.745	2.91*	10.37*
Authman *et al*. (2009)	Damietta branch (Egypt)	396	666	270	---	---		---	---	36.3	0.12	-1.12	2.20	23.88
Shalloof and El-Far (2009)	Abu-Zabal Lakes(Egypt)	---	---	---	1-4	1.7	12-22	$W = 0.0894\ L^{2.4034}$	0.979	34.59	0.1336	-2.09	2.20*	20.37*
Hassan and El-Kasheif (2013)	River Nile (Egypt)	---	---	847	1-4	1.34	16.3-28.5	$W = 0.0377\ L^{2.7924}$	0.951	48.14	0.147	0.2237	2.532	20.63*
Mahmoud *et al.* (2013)	Nozha Hydrodrome (Egypt)	---	---	---	2-7	---	14.5-31.5	---	---	38.06	0.211	-0.432	2.485	14.23
El-Kasheif *et al.* (2015)	El-Bahr El- Faraouny Canal (Egypt)	651	703	1405	0-6	2.13	4.8-33.6	$W = 0.0366\ L^{2.8006}$	0.956	37.265	0.294	0.089	2.61	10.29
Tesfaye and Wolff (2015)	Lake Koka (Ethiopia)	---	---	7933	---	---	---	---	---	44.5	0.41	−0.36	2.9	---
Yongo and Outa (2016)	Lake Victoria	---	---	2058	---	---	---	---	---	46.24	0.69	---	3.14	---
Khallaf *et al.* (2018)	Bahr Shebeen canal (Egypt)	191	122	313	0-4	2.13	11-30	$W = 0.01954\ L^{2.99931}$	0.99	39.21	0.171	-1.549	2.42	15.98
Khallaf *et al.* (2018)	Khadraweya canal (Egypt)	186	133	319	0-4	1.85	9-23	$W = 0.059100\ L^{2.55857}$	0.90	37.70	0.150	-2.018	2.33	17.93
Assefa *et al*. (2019)	Lake Tana (Ethiopia)	---	---	9289	0-7	---	4 – 40.5	---	---	44.1	0.44	−0.34	2.93	6.4*
Present study	River Nile in Aswan city (Egypt)	520	136	656	0-4	1.7	12-24.3	$W = 0.0496L^{2.6625}$	0.89	28	0.28	-1.9	2.1	8.8

* Calculated by the present authors

CONCLUSION

In conclusion, the data mentioned above indicate that this study presented valuable biological data concerning the age and growth of *O. niloticus* from the River Nile in Aswan city. These data reflect their good status in its stock. Furthermore, the selectivity of used fishing gear played a scientific role in determining age variation for fish caught, based on fish length and mesh size. This shows the importance of using a median and large mesh size to avoid small fish with a lower age group, which is considered for fisheries management and conservation.

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